AR 1 1962

FEBRUARY
1962

PRICE 75 CENTS

ELECTRICAL CONSTRUCTION AND MAINTENANCE

WITH ELECTRICAL CONTRACTING

CABLES UNDER PLASTER — an explanation of code rules applying to installation and mechanical protection. page 74

JETPORT POWER – electrical construction and installation features of the new jet-age air terminal in Los Angeles. page 65

WIRING A SHOPPING CENTER – design and construction techniques for lighting and distribution circuits in a new Phoenix, Ariz., project. page 91

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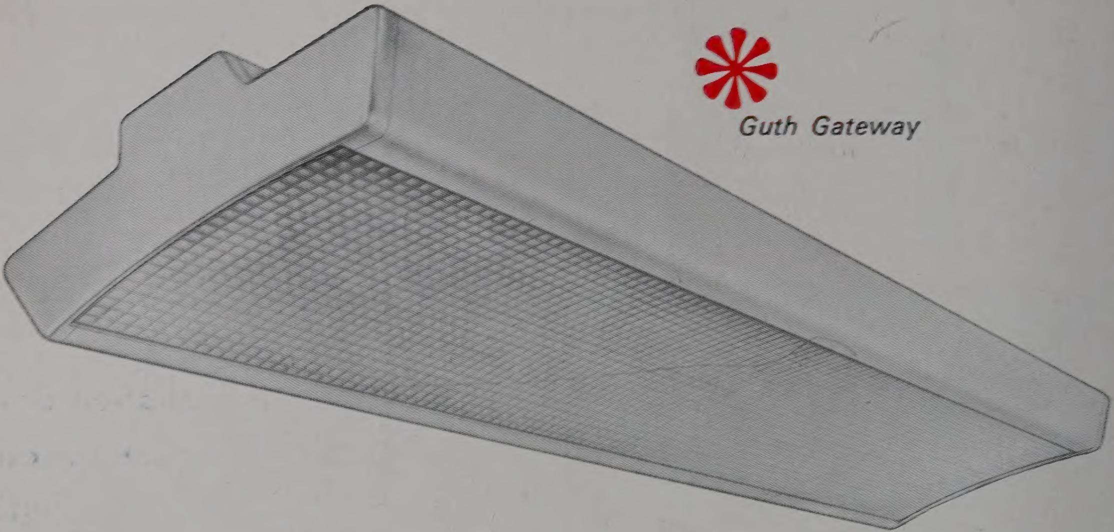


Sure it* looks good, but why specify it?

Gateway's intrinsic beauty is obvious. But that's only half the story. Here is the other half — engineering and construction features that make Gateway worthy of your specification. Gateway is *not* a wrap-a-round. The concave bottom actually hinges separately from the rugged 20-gauge steel ends. Simplifies relamping considerably — one strong panel, not an unwieldy basket, to hinge down.

The steel ends won't warp; also they add extra rigidity to the fixture in continuous-row mountings, or as individual units. (No glue or piano wire holding it together.) The 4′ or 8′, one-piece *tubular* plastic side wings with capped ends (minimize dust and dirt from holding conventions therein) offer greater strength and lower side-brightnesses.

The *concave* Gratelite* bottoms (choice of Prismoid** or Standard Gratelite) are solidly molded with built-in ultra-violet resistant additives. Both Gratelites feature ⅜″ open cubicles — dust and dirt filter thru — doesn't mar beauty.

All the steel parts, including the channel, are formed from electrolytic, *zinc-coated* and phosphatized steel. There's hardly any chance of their rusting regardless of humidity or climate. Each steel part is finished in the new super hard, super efficient *Acrylic* enamel. This is the finish automakers use, and say "never needs polishing". Paint people tell us "it most closely approaches the physical properties of porcelain enamel"

Of course, each unit includes a CBM/ETL Ballast, plus — we heat test Gateways to insure that ballast-case operating temperatures will not exceed 90°C in a 75°F room ambient temperature. (Add these last 13 words to every specification and watch competitors back away!)

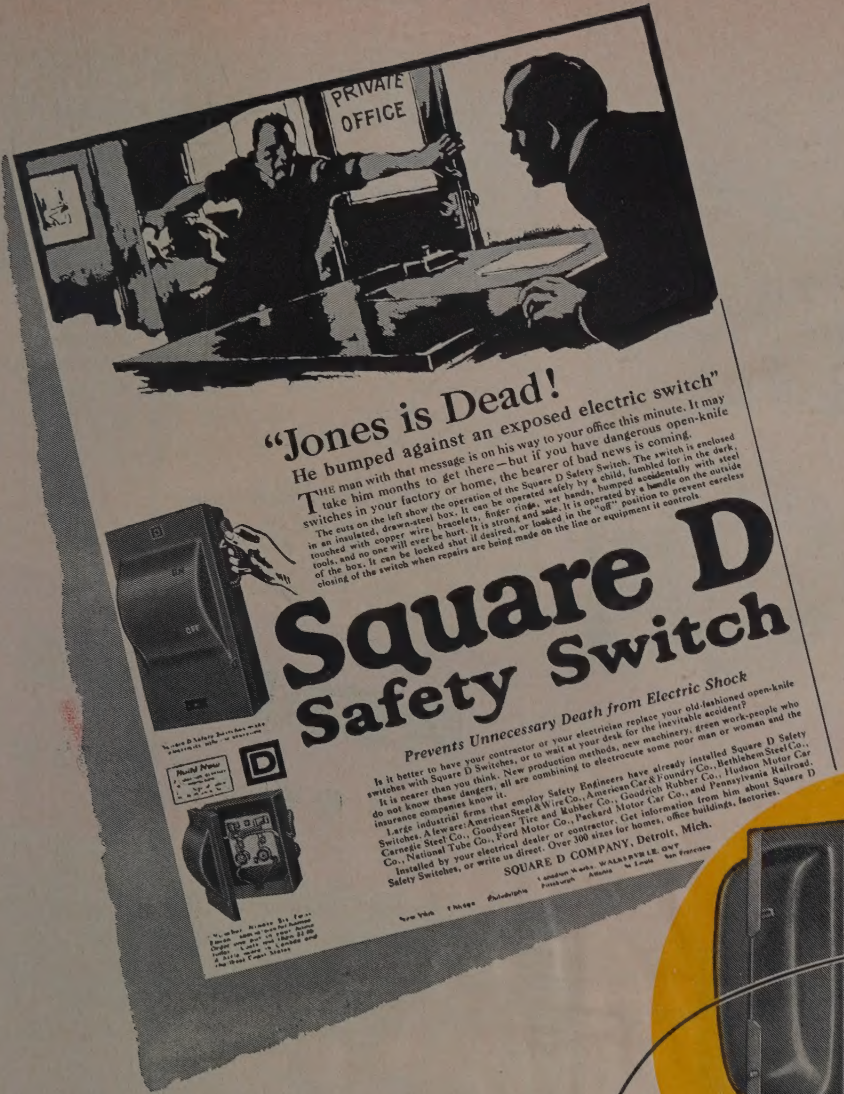
Gateway is available in *2, 3 or 4 lamps* — in the same "full-width" fixture — not a corridor looking unit in a carload.

For the final test, write us on your letterhead. We'll have our salesman show you a "live" demonstration of Gateway. If you just don't like salesmen, write us and we'll send our Gateway Brochure. In either case, you'll like Gateway, a fixture that proves itself.

Guth
LIGHTING
since 1902

THE EDWIN F. GUTH CO., 2615 WASHINGTON BLVD., BOX 7079, ST. LOUIS 77, MO.

* ® U.S. PAT. NO. 2,745,001 — CAN. PAT. 1957, NO. 538,245 — ** ® U.S. PAT. NO. 2,904,673



PRIVATE
OFFICE

"Jones is Dead!

He bumped against an exposed electric switch"

THE man with that message is on his way to your office this minute. It may take him months to get there—but if you have dangerous open-knife switches in your factory or home, the bearer of bad news is coming.

The cuts on the left show the operation of the Square D Safety Switch. The switch is enclosed in an insulated, drawn-steel box. It can be operated safely by a child, fumbled for in the dark, touched with copper wire, bracelets, finger rings, wet hands, bumped accidentally with steel tools, and no one will ever be hurt. It is strong and safe. It is operated by a handle on the outside of the box. It can be locked shut if desired, or locked in the "off" position to prevent careless closing of the switch when repairs are being made on the line or equipment it controls.

Square D Safety Switch

Prevents Unnecessary Death from Electric Shock

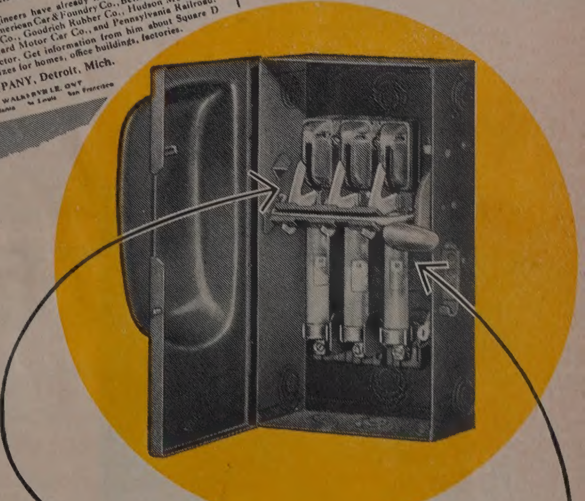
Is it better to have your contractor or your electrician replace your old-fashioned open-knife switches with Square D Switches, or to wait at your desk for the inevitable accident?

It is nearer than you think. New production methods, new machinery, green work-people who do not know these dangers, all are combining to electrocute some poor man or woman and the insurance companies know it.

Large industrial firms that employ Safety Engineers have already installed Square D Safety Switches. A few are: American Steel & Wire Co., American Car & Foundry Co., Bethlehem Steel Co., Carnegie Steel Co., Goodyear Tire and Rubber Co., Goodrich Rubber Co., Hudson Motor Car Co., National Tube Co., Ford Motor Co., Packard Motor Car Co., and Pennsylvania Railroad.

Installed by your electrical dealer or contractor. Get information from him about Square D Safety Switches, or write us direct. Over 300 sizes for homes, office buildings, factories.

SQUARE D COMPANY, Detroit, Mich.



BACK IN the days when we were running ads like the one above, it wasn't a question of which brand of safety switch—there wasn't any except Square D. Now there are a lot of different brands—have been for well over fifty years. But not once, during all that time, has Square D been anything but an overwhelming first choice.

We're not boasting. We're acknowledging the obligation of leadership.

We have a Safety Switch Bulletin which describes the complete line. Write for your copy.
Square D Company, Mercer Road, Lexington, Kentucky

VISIBLE BLADES

A lot of things can happen when a switch, believed to be open, isn't. And every one of them is bad. That's why it makes sense to insist on Visible Blade construction. You can SEE you're safe!

SAFETY HANDLE

is an integral part of the switch mechanism, not of the cover. No possibility of false handle indication. Impossible to defeat padlock provisions.

SQUARE D COMPANY

wherever electricity is distributed and controlled

Whether it's for the largest crane or smalles hand lamp, there's an APPLETON *Reelite* to pay out and retract cable with unfailing precision, safety, ease of handling. Made of finest quality materials and to APPLETON-engineered standards of perfection, they are the best you can buy for the purpose. Next time you need a retractable cable mechanism, investigate APPLETON *Reelites* . . . the finest!

Custom designed model Reelites can be developed to fulfill your requirements. As many as 36 conductors can be built into a single compact Reelite. Explosion-proof, weather-proof, vapor-proof . . . air, fluid, torque and tool-balance Reelites are all part of the vast variety of APPLETON reel models.

Gantry Crane with special (motor driven) constant duty *Reelite* paying out 500 ft. of 4/0 3-conductor 600 volt Type "W" cable

APPLETON® REELITES*
for every purpos

Installation using a custom built Type "EG" constant duty automatic take-up *Reelite* for unloading steel from gondola cars

Battery of 9 various *Reelites* mounted on moveable machine providing a wide variety of individual power leads to this large operation for power and control

Write for Bulletin No. 505

"YS" *Reelite* mounted to pay out cable for roving overhead electric hoist. 335° swivel. Provides maximum flexibility without dangers of snagging, plus elimination of electrical hazards

SYMBOL OF BETTER PRODUCTS.

APPLETON ELECTRIC PRODUCTS®

APPLETON ELECTRIC COMPANY
1701 Wellington, Chicago 13, Ill.

Also Manufacturers of:

Explosion-Proof Fixtures

Outlet Boxes

Industrial Lights

"ST" Series Connectors

ELECTRICAL CONSTRUCTION AND MAINTENANCE

with which is consolidated Electrical Contracting, The Electragist and Electrical Record . . . Established 1901

Published for electrical contractors, electrical departments in industry, engineers, consultants, inspectors and motor shops. Covering engineering, installation, repair, maintenance and management in the field of electrical construction and maintenance.

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New York's Electrical Strike, *An Editorial* 63

Jetport Power 65
By H. P. SCOTT—Primary service at 34.5 kv; an initial electrical load of 30,000 kva; nine substations; 530 miles of wire; 285 miles of raceways and 23,000 lighting fixtures in 24 buildings are some statistics related to huge new Los Angeles air terminal.

A Look at Code Rules on Cables Under Plaster 74
By J. F. McPARTLAND—Today's applications of armored and nonmetallic sheathed cables embedded in plaster finishes on masonry surfaces raise some questions about required mechanical protection.

Estimating Forum—XVIII 76
By RAY ASHLEY—Volume and operating costs—Part II.

Primary Distribution Powers a College 78
Employing corona-resistant, high-voltage cable, a 4160-volt primary system feeds a new multi-building college in Utica, N. Y. Here's a close-up on equipment selection and design details.

Machines Speed Underground Cable Work 82
Wood Electrical Construction, Inc. combines judicious use of machines with efficient field crew organization to accelerate trenching and cable laying at Chicago's O'Hare International Airport.

Troubleshooting Electronic Speed Controls 84
By A. P. JACOBS—Here's a basic analysis of a typical electronic motor speed regulator plus the latest techniques for effective troubleshooting and maintenance.

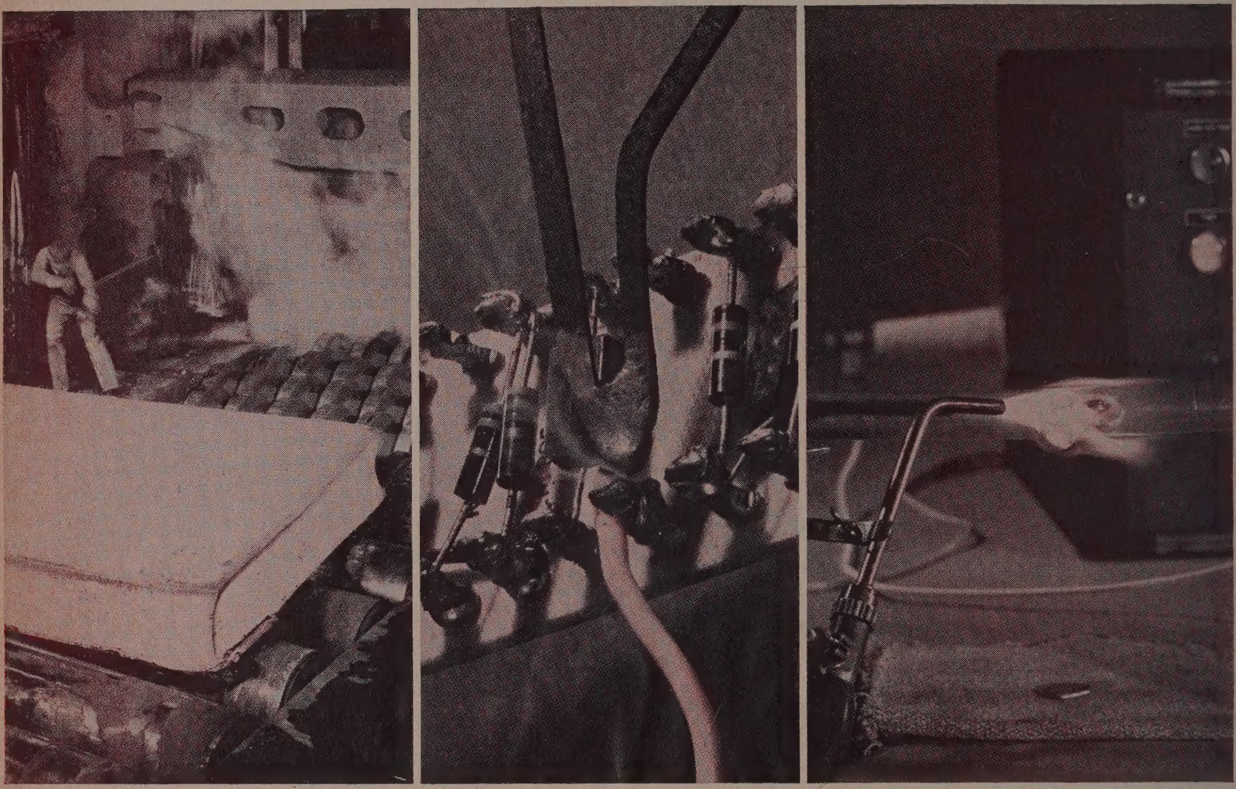
Interpreting Light Distribution Curves 88
By WILLARD ALLPHIN—The control and distribution of light by a luminaire is revealed by its photometric light distribution curve.

Wiring a Shopping Center 91
By W. B. KELLER—A roundup of design and construction techniques used for lighting and distribution circuits in Grandview Plaza Shopping Center, Phoenix, Ariz.

MORE

SILICONE NEWS from Dow Corning

Scorching heat...



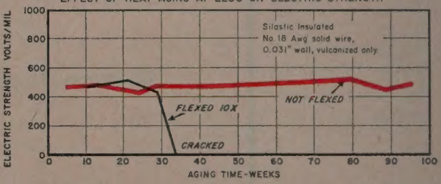
but still Silastic® insulation provides dielectric integrity

"***Hot*** as the hinges of Hades" is a good way to describe the ambient temperature in a rolling mill. Now add plenty of moisture, salt for cleaning the mill bed, dripping grease, hot scale and glowing plates of steel. The result is double trouble for insulation on exposed motor feeder cables. Yet, cable insulated with Silastic, the Dow Corning silicone rubber, has provided the world's largest rolling mill trouble-free service since 1955.

Hotter than melted solder, but Silastic insulation still stays on the job without softening or cracking. That's why Silastic insulated hookup wire speeds production, is easy to use, results in fewer opens and shorts on completed jobs.

Fire will burn Silastic insulation, but leaves behind a non-conductive ash which continues to insulate as long as it stays in place and remains dry. This is why you find Silastic specified as the control wire insulation in critical military and commercial installations in which communications must not be interrupted by fire damage.

Leading manufacturers offer power cable, control cable, hookup wire, fixture and building wire with insulation of Silastic. Why not investigate, now?


EFFECT OF HEAT AGING AT 225C ON ELECTRIC STRENGTH

Silastic insulation retains dielectric strength over a wide temperature span. What's more, its electrical properties are extremely stable and survive relatively unchanged even after long storage, weathering, thermal aging or heat cycling.

Write Dow Corning Corporation, Midland, Michigan, Dept. 3602 for detailed information and list of suppliers offering Silastic insulation on wire and cable.

first in silicones

Dow Corning

ELECTRICAL CONSTRUCTION AND MAINTENANCE

FEBRUARY • 1962 continued

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A uniform level of 100 footcandles on the playing field is achieved by a new floodlighting installation at Texas Tech's athletic stadium, installed by Monger Electric Company, Fort Worth, Texas.

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Questions on the Code 154

Answers to code questions on terminal identification; service extension; cable derating factors; NEC interpretations; multiple conductors; meters in services; grounding connections at boxes.

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"I've double-checked stock on every item, Jim. You'll have it all today!"

Do you need to know for sure just how many motors or controls of a size and type you can get fast — but *fast?* Switches? Circuit breakers? Transformers? And how many feet of conduit or cable?

Within minutes your Graybar Inside Salesman can give you an accurate answer — on any item you need.

Your Graybar Inside Salesman is equally alert to see that you gain *all* the benefits of Graybar service to the electrical contractor. He is one of four well-trained, experienced men on the Graybar contractor service team. The others: Field Salesman, Counterman, Specialist. The job of all is to *speed your work . . . reduce your costs . . . help you build your business.*

Call Graybar today and get this team working for you.

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Graybar Service includes: Objective recommendations • On-the-job technical help • Most complete lines • Planned stocks to meet your needs • Expert counter service • Speedy handling of will-calls.

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ELECTRIC COMPANY, INC.

Everything Electrical

420 LEXINGTON AVENUE, NEW YORK 17, N. Y. • OFFICES IN OVER 130 PRINCIPAL CITIES

Sidelights

WIRING A JETPORT

The new Los Angeles air terminal with its miles of runway and roadway lighting and 24 buildings is one of the outstanding electrical construction projects of the year. Using primary service at 34.5 kv, the initial electrical load is estimated at 30,000 kva handled by nine substations. The project is described by Associate Editor Hugh P. Scott in "Jetport Power" beginning on page 65.

ELECTRONIC CONTROLS

An analysis of a typical electronic motor speed regulator and the latest practical techniques for effective trouble shooting and maintenance is presented by A. P. Jacobs, Industrial Application Engineer of the General Electric Co., in the article "Troubleshooting Electronic Speed Controls" beginning on page 84.

NEW COST CURVES

This month our statistical index of the cost of electric materials starts a new series. Three separate bills of materials, characteristic of products used in residential, commercial and industrial practice are priced each month and compared with the base by the National Price Service of Cleveland, Ohio.

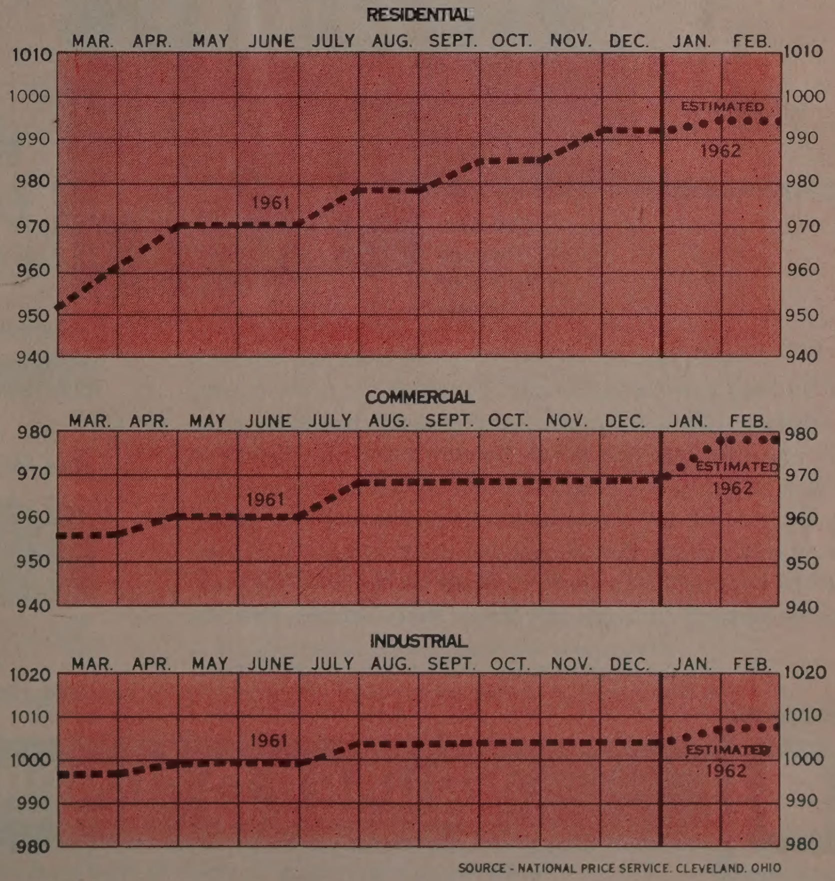
The former chart used a base (1,000) representing costs in 1951. The new series uses the base (1,000) representing the average cost of the bills of materials during the year 1960. The monthly index points represent variations in cost based upon prices current on the first of each month.

ELECTRICAL MATERIALS COST INDEX

CHANGES IN THE COST OF ELECTRICAL MATERIALS FOR EACH OF THREE TYPICAL JOBS ARE SHOWN ON THESE THREE CHARTS.

THE BASE (1000) REPRESENTS THE AVERAGE COST OF THE MATERIALS FOR THE YEAR 1960

THE MONTHLY INDEX POINTS SHOW THE VARIATIONS IN COST ON THE FIRST OF EACH MONTH.



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SAVE-
space
time
money

Same PANELBOARD COMBINES *Both* LIGHTING AND POWER LOADS!

NQO
Panelboard

Heavy Duty Construction!

100 AMP through 400 AMP MAINS

• Why waste time, space and money by installing separate lighting and power panelboards? Square D now makes it easy to combine 120 and 240 volt lighting and power loads up to 100 amperes, into one panel. Equally important, thanks to plug-in design and a complete range of circuit breakers (*at right*), you can get a real heavy duty industrial type panelboard with exactly the circuits you need—right out of your Square D distributor's stock*... ***Write* for the complete story.**
Address Square D Company, 1601 Mercer Road, Lexington, Kentucky

*NQO (plug-in) and NQOB (bolted connection) panelboards are also available factory-assembled for shipment direct to the job

FINEST BREAKER EVER BUILT!

THE **QO** FAMILY

QO 1-POLE 15-50 Amp	QO 2-POLE 15-70 Amp	QO 3-POLE 15-60 Amp	Q1 2-POLE 70-100 Amp	Q1 3-POLE 70-100 Amp

SQUARE D COMPANY

wherever electricity is distributed and controlled

Washington Report

FEBRUARY • 1962

Federal spending is soaring to new peacetime records, as reflected by President Kennedy's budget proposal for fiscal 1963 which begins next July 1st. This budget, submitted to Congress last month, calls for administrative expenditures in the 1963 fiscal year of $92.5 billion, up $3.4 billion from fiscal 1962. Budget revenues for 1963 were estimated at $93 billion, up $10.9 billion from this year's (fiscal 1962) receipts. Estimated deficit for 1962 is $7 billion ($89.1 billion expenditures and $82.1 billion receipts). Most of the 1963 spending increase would go for defense, space exploration and interest on the national debt.

Total Federal spending for 1963, including social security and other payments not included in the "administrative" budget, will be approximately $115 billion, or roughly one-fifth of "gross national product." Currently (fiscal 1962), total annual spending by government—Federal, state, local— is estimated at $173 billion, or over 40% of total personal income estimated for the same period and about one-third of "gross national product."

The Social Security tax rate went up one-eighth of one percent for each individual employee on January 1st. This brings to 3.125% the tax paid by each individual on the first $4800 of his annual income. An additional 1½% Social Security tax has already been approved by Congress, to take effect as follows: ½% on January 1, 1963; ½% on January 1, 1966; and ½% on January 1, 1969. At that time, each individual worker will pay 4.625% of the first $4800 of his annual income, or $444 per year. An equal amount will also be paid by the employer. Thus, the total Social Security tax levied against each individual worker will be 9.25% of the first $4800 of his annual income, or $888 for individuals earning $4800 or more per year.

Space for fallout shelters to protect 50 million Americans is being searched for in large buildings, mines, caves and tunnels. Some 1300 architect-engineers are now under Government contract on this program, hope to complete the search by July, after which Office of Civil Defense, now operating under Department of Defense supervision, will stock these shelters with survival food, water containers and fallout detection gear.

Under an Administration-proposed new program which requires Congressional approval, Federal aid would be made available for up to 60% of the cost for building community fallout shelters in schools, hospitals, and community welfare institutions. Cost of this program over 4-year period would add up to an estimated $3.3 billion. State and local governments would pay the rest of cost for these shelters.

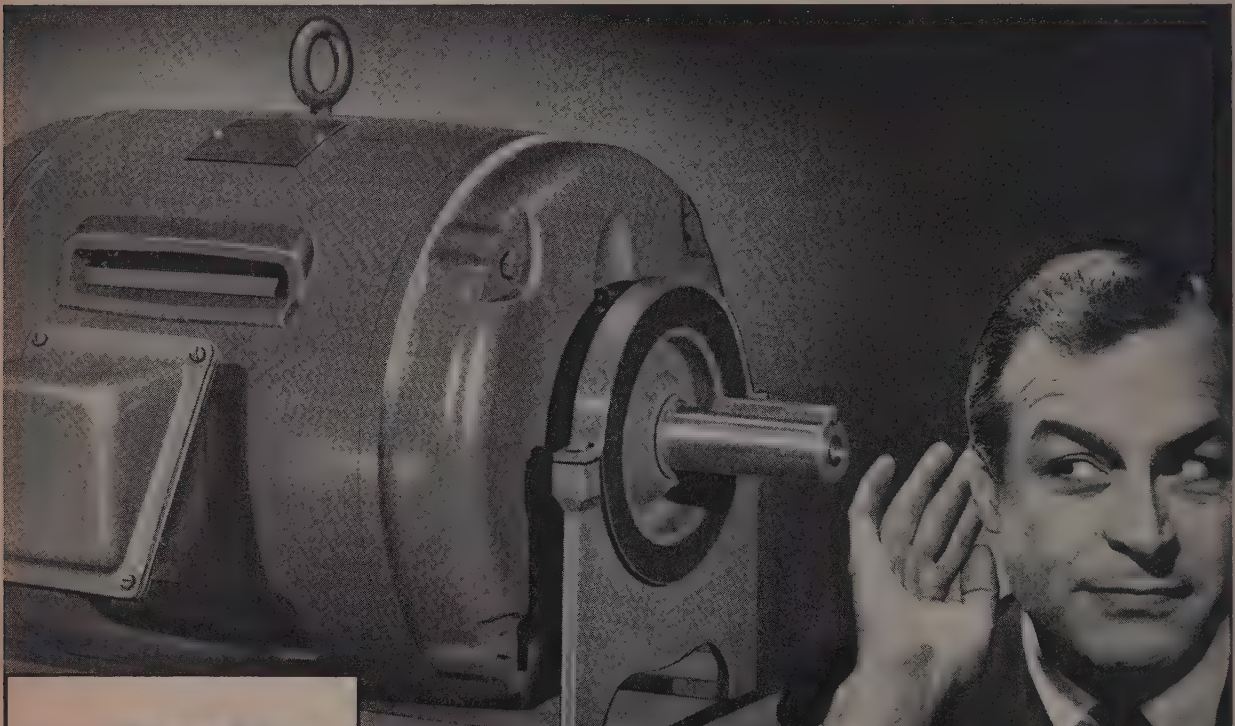
Federal Power Commission wants $380,000 to complete a survey begun in 1933. Project is a national survey of the nation's future electric power needs, over the next 20 years, and how to meet them.

Civilian employment by Federal executive agencies last November was 77,000 higher than a year earlier. Total employed was 2,438,000. President Kennedy's budget proposal for fiscal 1963 includes an increase to 2,538,000 by mid-1963, or 100,000 more employees.

WHISPER-QUIET

WAGNER® POLYPHASE RESILIENT-MOUNTED MOTORS

(Ratings Through 10 HP)



CEILING, SIDEWALL OR HORIZONTAL MOUNTING

You can mount these motors on walls or ceilings by rotating the cradle base 90° or 180°. Motor stays dripproof.

When you need polyphase motor drives that are *quiet* in operation . . . in hospitals, schools, churches, office buildings, radio or TV stations and similar locations . . . specify Wagner® Resilient Mounted Polyphase Motors.

These smooth running *standard* motors are cushioned in cradle bases by neoprene mountings, bonded to steel rings. This construction absorbs the small running vibration that remains in the most carefully dynamically balanced motor.

Apply them to fans, blowers, centrifugal pumps, compressors, and commercial refrigeration and air conditioning equipment. You'll get ultra-quiet operation. Only Wagner can provide an entire range of ratings through 10 horsepower—and Wagner is a name you can depend on for quality motors.

Your nearby Wagner Sales Engineer can help you select the right motor for your application. There are Wagner branch offices in 32 principal cities.

SLEEVE OR BALL BEARING. These motors are furnished with quiet running steel-backed babbitt-lined sleeve bearings of high load carrying capacity. Ball bearings can be supplied when desired.

NEOPRENE CUSHIONING RING. Annular mountings, of oil-resistant neoprene, bonded to steel rings, cushion the motor in its cradle base to provide ultra-quiet operation.

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Manufacturers of LOCKHEED® Products

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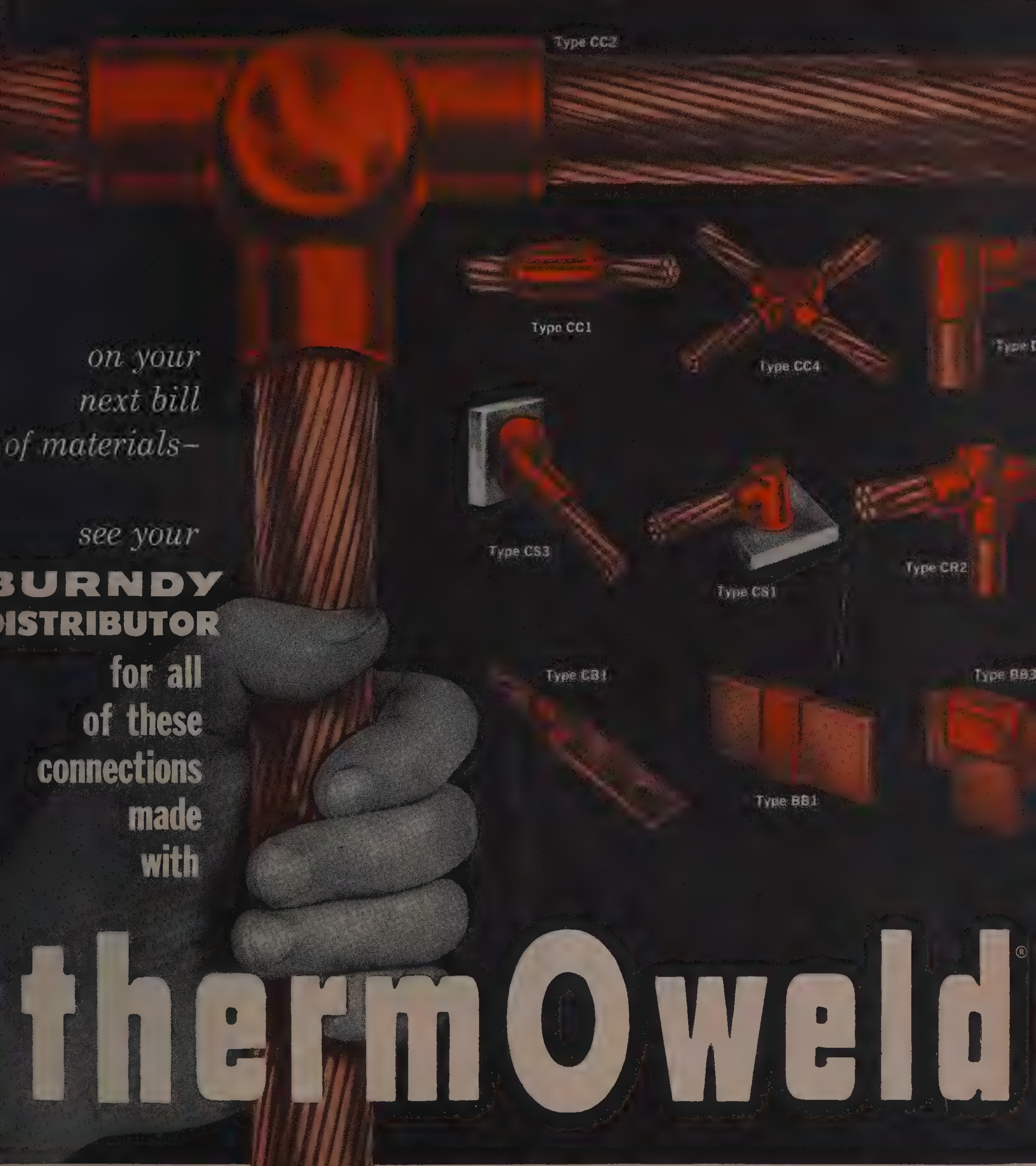
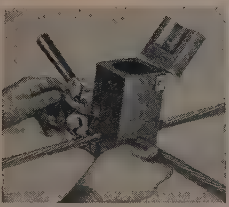


on your
next bill
of materials–

see your
BURNDY
ISTRIBUTOR
for all
of these
connections
made
with

thermOweld®

weld a permanent
electrical connection
sily and economically
any copper conductor
or steel structure



Weld anywhere with lightweight THERMOWELD. Self-contained, needs no external source of power.

Pour powder into mold, tap. Starting powder won't mix with welding powder, assures positive firing.

Close cover, ignite with flint gun. THERMOWELD forms liquid copper which fuses conductors into solid mass.

BURNDY

407

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DuKane

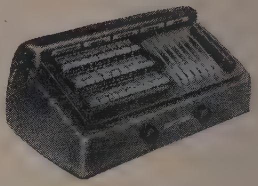
INDUSTRIAL SOUND SYSTEMS

PRIVATE AUTOMATIC TELEPHONE SYSTEMS

DEPTH OF LINE!

OFFERS ONE SOURCE FOR ALL YOUR COMMERCIAL SOUND AND COMMUNICATION NEEDS

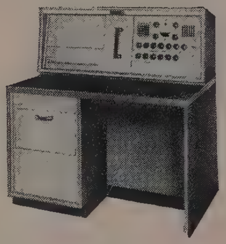
600 SERIES PAGING TELEPHONE SYSTEMS



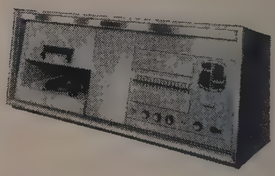
INTERCOMMUNICATION SYSTEMS

One call to one man, your DuKane distributor, provides you with all you need for any commercial sound and communication system. Paging, program distribution, internal communications, clock signal systems, are just some of the systems with which he is completely familiar. And that's not all.

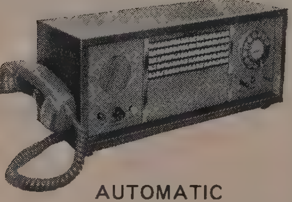
Together with this complete line comes the know-how to design and install the system for maximum life, serviceability, and good looks. This know-how, born of training and experience, is the result of countless DuKane commercial sound and communication installations in: schools, industrial plants, hospitals, institutions, sports areas, churches, hotels, etc.



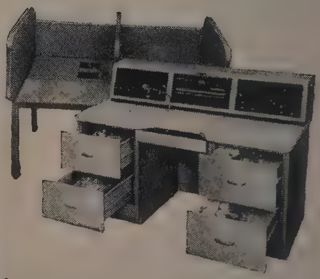
SCHOOL SOUND SYSTEMS



COMPACT MULTI-FUNCTION SOUND SYSTEMS



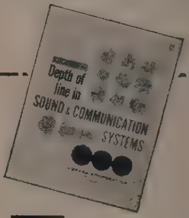
AUTOMATIC AUDIO-VISUAL NURSES' CALL SYSTEMS



LANGUAGE LABORATORY SYSTEMS

Your DuKane distributor has *depth—depth of line, depth of experience, depth of service.* Contact him—get his know-how working for you now.

WRITE TODAY FOR FULL DETAILS ON ALL DUKANE SOUND AND COMMUNICATION SYSTEMS



NAME______________________________

TITLE______________________________

FIRM______________________________

STREET______________________________

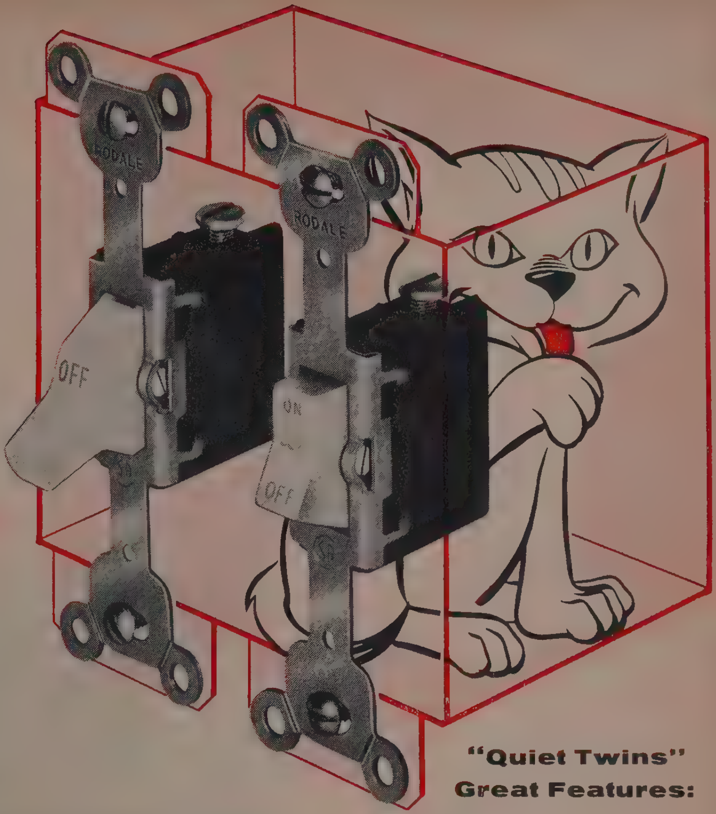
CITY_______________STATE__________

DuKane
CORPORATION
COMMERCIAL SOUND DIVISION
DEPT.ECM-22/ ST. CHARLES, ILLINOIS

THE STRONG

Quiet Twins®

so small you can throw an Alley Cat in the Wall Box along with them...



AVAILABLE WITH ROCKER BUTTON OR STANDARD TOGGLE

Through extensive and timely engineering research, RODALE QUIET TWINS now employ an exclusive principle (patent applied for) which assures longer switch life and smoother, quieter operation.

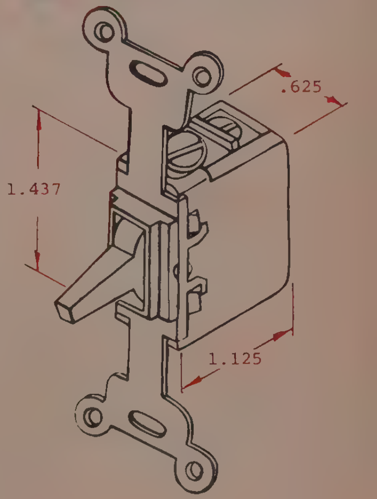
It is this very principle which makes possible the uniquely *small* SIZE of the body.

Amazing . . . the ease with which these quiet switches are installed. The diminutive size of the switch body leaves more room all around for bulky wires.

Another easy installation feature . . . the heavy steel mounting straps are delivered with mounting screws already in place. *Quiet operation is achieved without the use of rubber pads which can deteriorate silver alloy contacts.* Eliminating this objectionable characteristic has greatly added to the life of the switch and improves the firm, quiet operation.

Rodale's silver alloy contacts are life lasting and assure the best circuit completion possible.

"Quiet Twins" Great Features:



- *Smallest Quiet Switches*
- *Firm, silent operation*
- *Life Lasting silver alloy contacts*
- *No possible deterioration due to chemical reaction with rubber bumpers*
- *Available in brown or ivory*

Rated 15 Amps., 120-277 Volts A. C. only . . . available in Single Pole and Three Way . . . UL and CSA Approved . . . 100% factory inspected and tested.

A RODALE EXTRA VALUE FEATURE

1
2
3
4
5
6
PAT. APPLIED FOR
SPECIFY
Touchette
SWITCHES
Rodale
Simply place template over switch buttons before tightening strap screws. Insures proper wall plate alignment.
"SWITCH LOCATOR"

For ease in properly aligning switches when multiple gang installations are involved, Rodale has designed the "Switch Locator" template. This template is simply placed over the switch buttons. The slots hold the switches in proper position while the strap screws are being tightened to assure a perfect wall plate fit the first time. Every package of ten switches includes a "Switch Locator". These templates are also available for the asking direct from Rodale.

Sold only through electrical wholesalers, or for further information and prices, write Rodale direct.

Rodale / manufacturing co., inc.
dept. L-1, emmaus, pa.

See the Complete Rodale Line at the 6th National Electrical Industries Show — N. Y. Coliseum — March 11-14, Booth 325

NATIONAL
ELECTRICAL
WEEK
FEB. 11-17, 1962

NEW ANACONDA HOT-SPOT CABLES FILL THE COST-TEMPERATURE GAP BETWEEN STANDARD BUTYL AND SILICONE-INSULATED CABLES

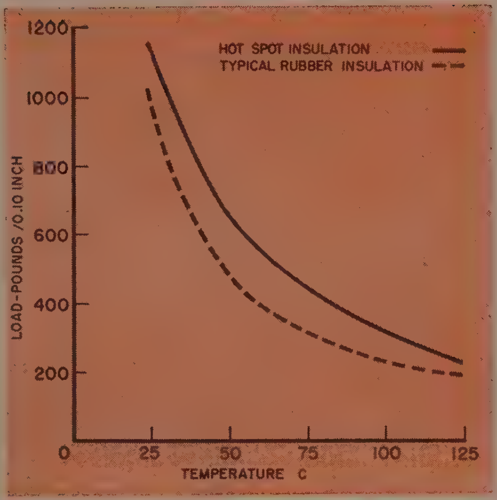
...and outlast ordinary cables three to one

Anaconda has developed new butyl compounds for cables that perform well at temperatures up to 125C, and cost less than silicone cables. Called Hot Spot, these new compounds last two or three times longer than ordinary insulation. That's because Hot-Spot insulation won't craze, won't become brittle, retains high tensile strength at high temperatures. Hot Spot has low moisture-absorption characteristics, too. It's the ideal insulation for wiring on soaking-pit cranes and lids, annealing and melting furnaces, hot-rolling mills, boilers and kilns.

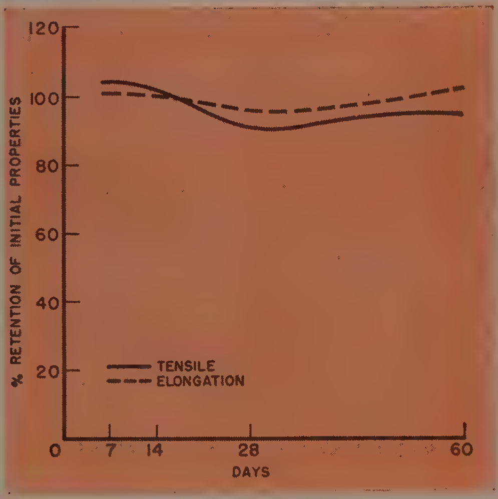
Hot spot cables are available in power, control, and portable-cord constructions.

They have already run up some remarkable records. For example: an Ohio roller bearing plant replaced rubber-insulated asbestos-covered cables with Hot-Spot cables in May 1959. The rubber-asbestos cables used to last three or four months; the Hot-Spot cables are still in use, more than two years later . . . a 300% increase in service life.

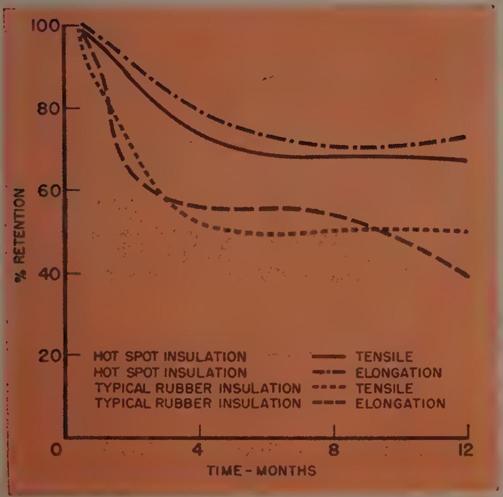
See for yourself how Hot Spot holds up in rugged conditions. Check over the charts on the next page for convincing evidence. For more details, contact Anaconda Wire and Cable Company, 25 Broadway, New York 4, New York, Department EFL-2-ECM.



Compression Cutting Test—Hot-Spot butyl insulation consistently offers greater resistance to compression cutting at elevated temperature than typical rubber insulation.



Air-Oven Test—Hot-Spot butyl jackets retain almost 100% of original tensile strength and elongation properties in two-month 121C air-oven test.



Year-long Current Loading Test—Hot-Spot butyl insulation retains over 70% of its original tensile strength in year-long current-loading test (conductor temperature 121C).

61306

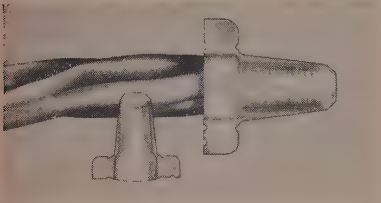
ASK THE MAN FROM

ANACONDA®

FOR HOT-SPOT BUTYL WIRE AND CABLE

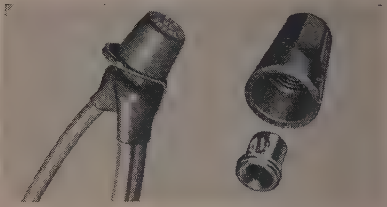
Maintenance Mart

THESE POPULAR IDEAL PRODUCTS ARE ALL AVAILABLE FROM YOUR LOCAL DISTRIBUTOR



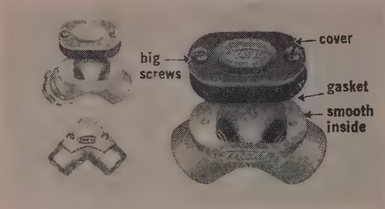
Built-in wrench. Unique wings make WING-NUT easiest wire connector to screw on heaviest branch circuit wires. Splice is visible inside tough nylon shell. U.L. listed for 600 volts as pressure cable connector, and 105°C. U.L. approved for aluminum and solid and/or stranded copper wires. 2 sizes of WING-NUT available to meet all pigtail splice needs.

America's favorite! WIRE-NUT has long-proven performance record as lowest-cost method for all common branch circuit and fixture wire connections. Strongest, shake-proof wire joint possible. All 5 sizes U.L. listed as 300v fixture; large sizes 74B & 76B as 600v pressure cable connectors. Use WIRE-NUTS in all types of conduit, cable, non-metallic sheath and open wiring.



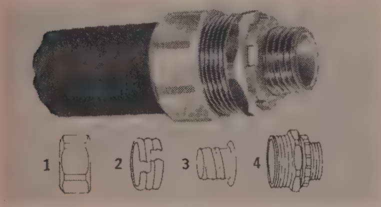
Select Set-Screw or Crimp. Only Ideal CRIMP has WRAP-CAP that insulates all around and even between wires. 600v U.L. approved for cadmium plated steel sleeve and vinyl 1-piece WRAP-CAP . . . now 2 sizes. 3 sizes of Ideal SET-SCREWS. All U.L. listed. Shell and connector easily removed and re-used. Tough shell has long skirt to prevent flash-over.

Cut "fishing" time. Highest grade, oil-tempered flat spring steel FISH TAPES will not curl. Flexible and easy for long, multi-bend conduit runs. Steel reel holds tape, is handled with safe, sure grip and ends danger of bending, kinking or breaking tape. Used with flexible leader, solves 90% of fishing problems. ⅛" and ¼" tapes in 50, 100 and 200 foot coils.

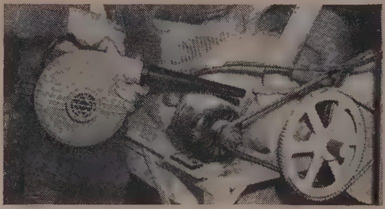


Easiest way around! Ideal PULLING ELBOWS & ADAPTERS make wiring around corners a snap. Precision milled of malleable iron for rugged strength and perfectly smooth pulling. Precise 90° fit. Cadmium plated, chromate treated. Supplied assembled, complete with rigid domed cover, full neoprene gaskets and BIG screws. ½" to 2" sizes, in three styles.

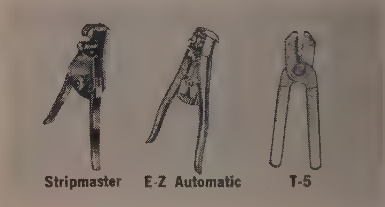
Double protection—Ideal VOLTAGE TESTER has a solenoid, calibrated indicator and a neon test lamp . . . each independent of the other. Safest, easiest for rugged daily use. Plastic safety yellow case, no-slip prods, prod storage space, fits pocket. Tests voltage, frequency, AC or DC, continuity, etc. Also model with resistor-fuses in prods to prevent arcing.



Vap-Oil-Tite—only completely reusable connectors for liquid-tight, flexible metallic conduit. Perfect seal. Positive ground, covers raw conduit end, fits EF and UA. U.L. approved. 90°, 45° and straight for ⅜" to 4" sizes. Easy to apply: Slip ring nut (1), and split ring (2), on conduit. Screw grounding bushing (3) inside conduit. Tighten ring nut over connector (4).



Vacuum cleaners and blowers. Blows dry air at high velocity but low pressure, so safe for delicate equipment. Light, balanced hand models for heavy, medium or light duty, complete with blower nozzle. Available with hand model or tank-type cleaning attachments. Ideal CLEANERS do better job faster, at less cost. Universal type motor lubricated for life.



Strip wires fast and easy. "One-squeeze" STRIPMASTER strips both solid and stranded wire in 2 seconds. Heavy-duty E-Z AUTOMATIC cuts thru toughest insulation and strips wires clean without crushing ends. Low cost T-5 STRIPPER cuts, strips and loops wires. Fits flat in pocket. Strips 10 to 18 gauge. Many other special Ideal hand stripper models available.

In-place motor maintenance. Service commutators, motors without dismantling . . . use Ideal commutator resurfacers, brush seaters, flexible abrasives. All sizes and styles to fit any job. Ideal line also includes everything for commutator care: precision grinders, mica undercutters and many specialized small tools. See your distributor.

FREE MAINTENANCE PRODUCT CATALOG. You can obtain your own **free** copy of the complete Ideal Maintenance Catalog giving details on thousands of items you need for regular and special maintenance jobs. For free copy, send your name, company name, and address to: IDEAL INDUSTRIES, 1041-B PARK AVENUE, SYCAMORE, ILLINOIS. Write today!

IDEAL

THE HELPING HAND
ON EVERY WIRING JOB

IDEAL INDUSTRIES, INC.
1041-B Park Avenue
Sycamore, Illinois
In Canada: Irving Smith, Ltd., Montreal.

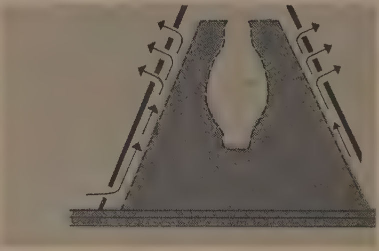
All the fine maintenance products above are manufactured by IDEAL. All are available from your local IDEAL DISTRIBUTOR.

VHAT'S IN THIS NEW NDOOR LUMINAIRE FOR YOU?

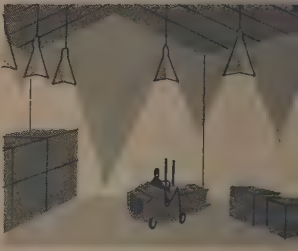
More light, less glare, lower installation costs. You get all these advantages from Wide-Lite's no-holds-barred attack on interior industrial lighting problems. For more facts on this unique new fixture, just turn the page . . .

HERE'S WHAT'S IN THE NEW WIDE-LITE INDOOR LUMINAIRE FOR YOU!!!!!

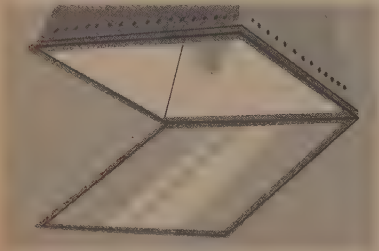
More Light! You get more than twice as much light from this rectangularly-shaped luminaire as you would from an incandescent unit of the same wattage. And the highly efficient segmented reflector system puts this extra light right where you want it, without shadows or hot spots. What's more, this Wide-Lite fixture's output, unlike fluorescent units, does not drop when room temperature is low!



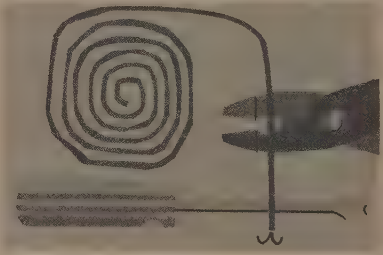
Longer lamp life! Lamps last longer and their color-correction characteristics are retained better when they are properly cooled. Exclusive Wide-Lite "flue-cooling" sweeps cool air **through** the double-walled fixture body to maintain the most efficient lamp temperature.



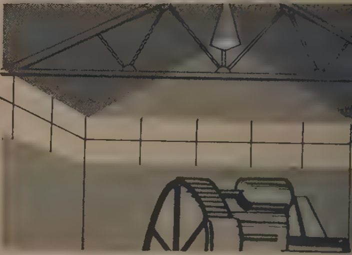
Less glare! Wide-Lite uses a merc
vapor lamp—a big, low-glare light sou
—to gain a head start in the freed
from-glare department. But the
Wide-Lite fixture has even less glare t
other mercury vapor units. Its la
is recessed deep in the fixture, and
unique flat reflectors don't **focus**
light. This new glare-free Wide-Lite
a blessing to lift truck operators
others who must look **up** as they w



Lasting efficiency! A sealed, gasketed lens keeps dirt, bugs and grime off the reflector and lamp to give you continued high light output. The tempered glass lens swings down to permit safe, easy relamping. (This is a feature you won't use often—but it's great when relamping is needed!)



Installation economy! Pre-wired ballasts save as much as **one-half** the installation time on each unit—saving many dollars on the average installation. And, of course, mercury vapor Wide-Lite units make possible big savings in wiring, conduit and switch-gear as compared with incandescent and fluorescent lighting!



Reduced maintenance cost! "Flue-cooli
and heat-resisting Class B insulation transfo
ers protect the ballasts and let you ins
these new Wide-Lite fixtures without worr
about high air temperatures near the roof
ceiling. Exclusive—only Wide-Lite ballasts c
a **three year** guarantee against failure!

WIDE-LITE CORPORATION
4114 Gulf Freeway • Houston, Texas Dept. AB111

Please send more information about the unique new Wide-Lite indoor luminaires.

NAME__________

COMPANY__________

ADDRESS__________

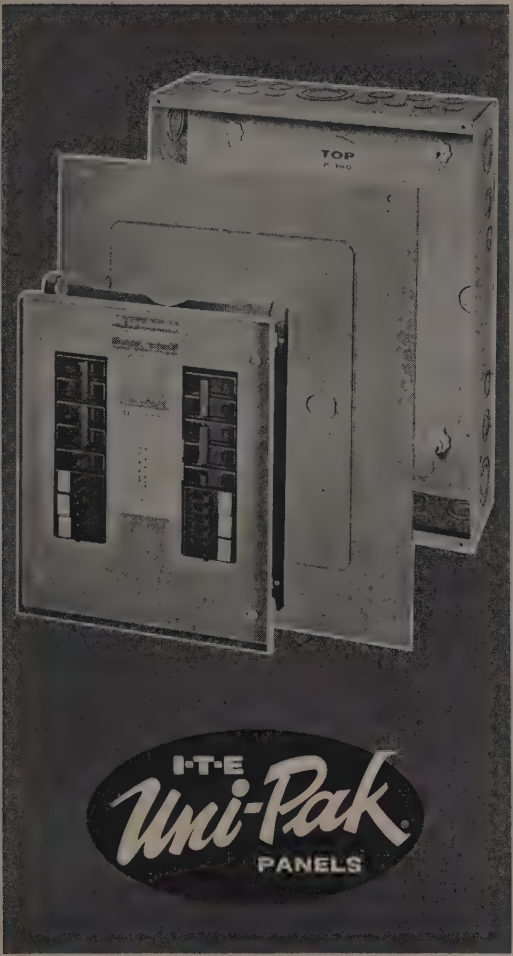
CITY__________ZONE_____STATE__________

**New Wide-Lite indoor luminaires are available for use with 1000
400 watt or 250 watt mercury vapor lamps. Models are available wit
pre-wired ballasts when remote ballasts are desired. For more f
dimensions, and technical data, just send the coupon. Why not d
right now?**

WIDE-LITE.

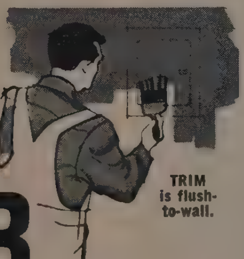
HIGH EFFICIENCY FLOODLIGHT

WIDE-LITE CORPORATION • A Division of Esquire, Inc.



I-T-E CIRCUIT BREAKER OADCENTERS

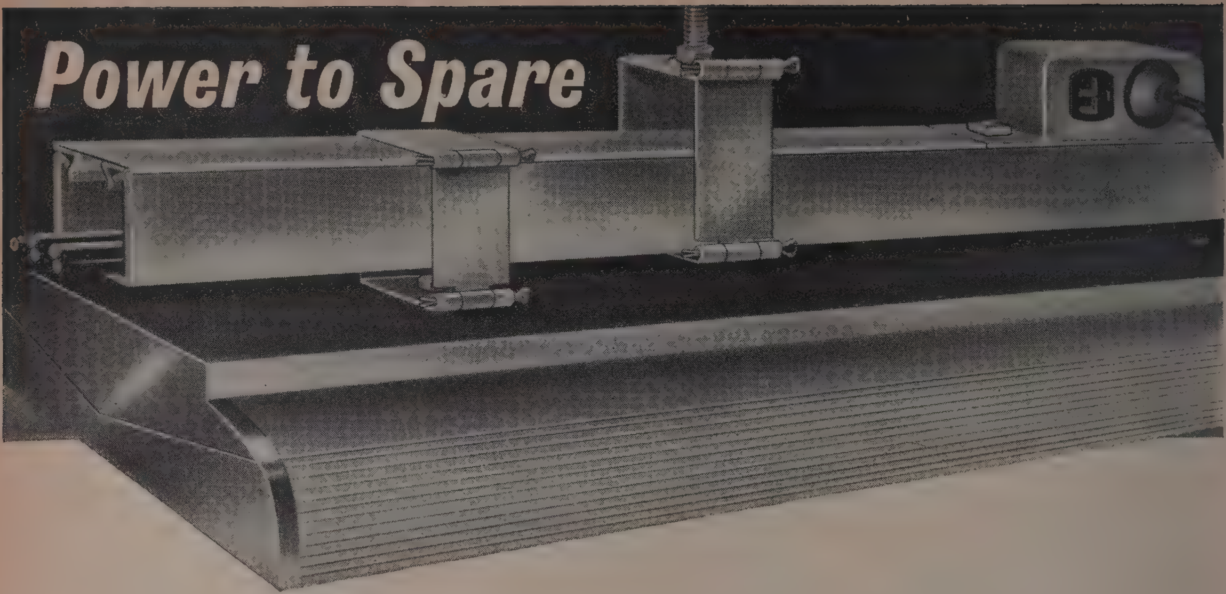
Specify I-T-E! Panelboard-type construction assures commercial quality in a residential product! And, separate Uni-Pak packaging speeds installation. First, you mount the 14¼″ Uni-Pak box snugly between 16″ stud centers . . . *hang* either fusible or breaker interior as you would a picture . . . *add trim* and job's done! You do not tie-up working capital if you buy the box, interior and trim separately to install separately. *Write to I-T-E CIRCUIT BREAKER COMPANY, WALKER DIVISION, 125 Bennett Street, N. W., Atlanta 9, Georgia. Ask for the SPEEDFAX CATALOG.*



TRIM is flush-to-wall.

or the contractor who is proud of his work!

I-T-E CIRCUIT BREAKER COMPANY
WALKER DIVISION



Steel City Channel MOUNTS, HANGS & FEEDS the fixtures

FOR SURFACE OR SUSPENDED LIGHTING

POWER TO SPARE—

A central wiring distribution channel with conductor capacity that exceeds requirements of any lighting layout and with power to spare for other uses. Here's a Channel that adapts to any interval of structural support—may be dropped to any level where it becomes a rigid platform for fixture attachment. Lighting fixtures may be spaced and fastened anywhere along the Channel System.

Branch lighting circuit conductors are completely enclosed in Channel from panel to fixture. This raceway carries full Underwriters' Laboratories, Inc. approval.

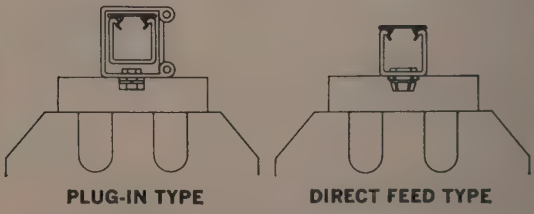
Fixtures may be added or relocated as required. To remove fixture, merely un-plug cord, open sliding fixture hangers and lower fixture. It's that easy.

MONEY SAVING FEATURES . . .

● Eliminates cutting and threading of conduit ● Reduces number of hangers ● Uses existing boxes for wiring feeds ● Plug-in method reduces wiring costs ● The greater hanger spacing allows use of existing boxes with fewer intermediate hangers ● Pre-wiring of long lengths of channel at bench level ● Top mounted receptacles provide outlets for portable tools and machinery.

SURFACE RACEWAY SYSTEMS

LISTED BY UNDERWRITERS' LABORATORIES, INC.



PLUG-IN TYPE

DIRECT FEED TYPE

Channels of various depths and gauges, for use as surface raceway wiring systems or for fixture support only, are available as standard.

When used as a raceway, the Channel capacities are more than ample for every lighting requirement—up to ten No. 8 AWG conductors (National Electrical Code).

▶ Write for Free Booklet G-2

Easy removal of fixtures for ballast repair and cleaning reduces maintenance costs.

STEEL CITY ELECTRIC COMPANY PITTSBURGH 33, PA.
A subsidiary of Martin Marietta Corp.

88'S THE ANSWER to COLD-WEATHER SPLICING

"SCOTCH" Brand No. 88 Electrical Tape zeroes in on one of your toughest problems . . . cold weather splice wrapping. 20% thicker than regular vinyl tapes, No. 88 is compounded and specifically designed to conform readily even in frigid temperatures. It has the perfect "feel" for completing fast, easy splices, and even when the temperature soars above the hundred mark this tape is formulated so its dependable protection lasts. It insulates and shields splices in heat, cold, any weather.

See for yourself! For free sample roll, write: Electrical Products Division, 3M Co., St. Paul 6, Minn.

3M MINNESOTA MINING & MANUFACTURING CO.

Goes on SLICK in freezing cold!

Made to STICK in any weather!

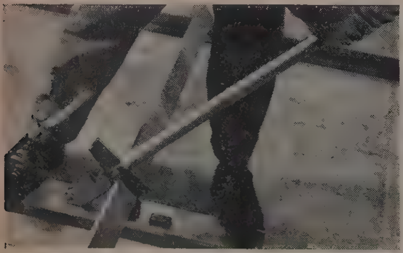
"SCOTCH" IS A REGISTERED TRADEMARK OF 3M CO., ST. PAUL 6, MINN.

New General Electric *FLEXWAY* Wiring offers great flexibility . . . meets tomorrow's needs as easily as today's

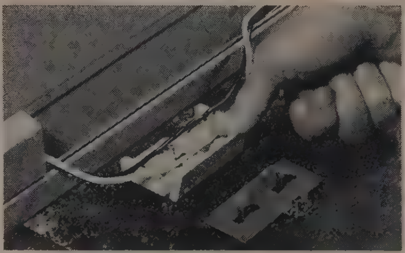
Installs whenever, wherever wanted — On, not In — any type of wall

New G-E FLEXWAY* Wiring runs almost anywhere —surface-mounted in a small, neat steel raceway that becomes a baseboard, door casing, chair rail, or vertical riser. It is ideal for commercial and industrial buildings, because of its flexibility in meeting changing needs—and for homes built with new prefab components (like sandwich panels)—where in-wall wiring is impractical.

General Electric Flexway Wiring is U.L.-listed; a safer, rugged grounding system. (15A, 125V—20A, 125V—and 15A, 250V grounding outlets available.)



Switches and outlets can be located wherever needed, in General Electric Flexway Wiring. Devices fit onto a base channel, and the spaces between them are closed with raceway covers, easily cut to length with a special tool.



Outlets can be added or moved at any time, *without* cutting or stripping wires! G-E Flexway Wiring outlets have insulation-piercing, clamp-type terminals that make automatic "loop" connections anywhere along insulated wires.

An offset screwdriver lays any part of the system open, quickly, for replacements or additions. Write for details on new G-E Flexway Wiring, to: General Electric Company, Wiring Device Department, Providence 7, Rhode Island.

**Trade-mark of General Electric Co.*

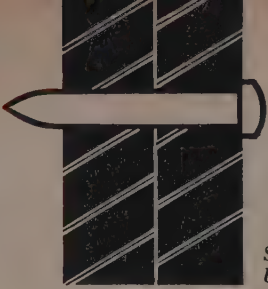
Progress Is Our Most Important Product

GENERAL ELECTRIC

MEDALLION HOME LIVE BETTER ELECTRICALLY

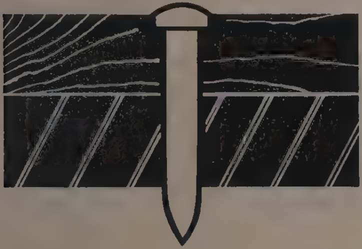
KEEP PACE ELECTRICALLY

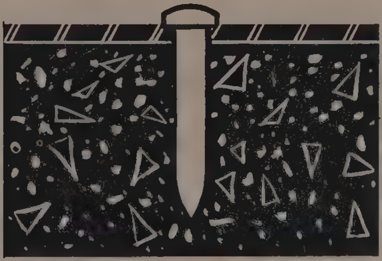
Discover All The Ways Powder Actuated Tools Work For You!



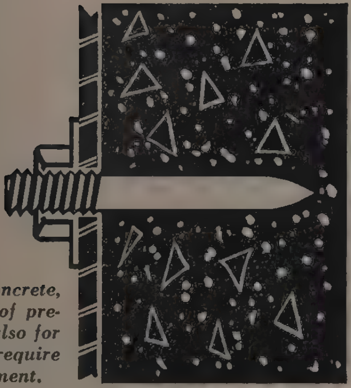
Steel to steel, such as angles and brackets to beams.

Wood to steel, wherever such application is required.



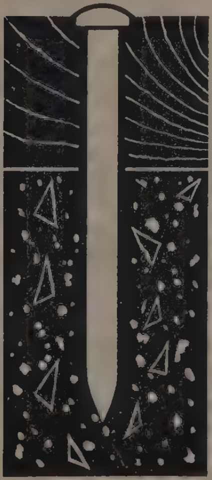


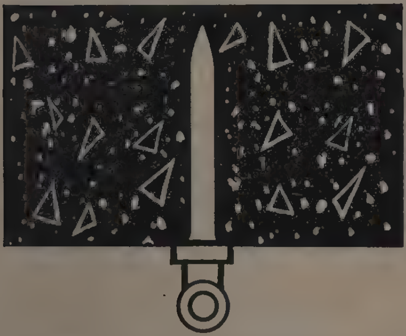
Steel to concrete, such as conduit and pipe clips; duct straps, angles, brackets and braces.



hreaded studs to concrete, ch as attachment of pre-illed materials — also for aterials that may require moval or replacement.

Wood to concrete, such as furring strips, sill plates, partition plates.





Overhead concrete installations, such as drop ceilings, electrical fixtures.

The distinctive sound of powder actuated tools has replaced much of the wearying staccato of traditional fastening methods; and because of their fatigue-saving advantages the tools offer greater efficiency than less modern fastening equipment.

Powder actuated tools, with their complete mobility and light weight, satisfy an extremely wide variety of fastening needs: wood to concrete; steel to concrete; steel to steel — wherever fastening is required. To help you discover more ways powder actuated tools can work for you, the Powder Actuated Tool Manufacturers' Institute provides a free portfolio of current information. Simply mail the coupon today!

For the best in powder actuated tool fastening, rely on these brand names of member companies:

NELSON | OMARK | RAMSET

REMINGTON | STAR

To: Powder Actuated Tool Manufacturers' Institute, Inc. ECM
Attn: Al Lane
200 College Street, New Haven 10, Connecticut
Please send me information on powder actuated tool fastening.
NAME__________ TITLE__________
COMPANY__________
ADDRESS__________
CITY__________ ZONE_____ STATE__________

No representative will call, unless you so request.

Current news reports

WHAT'S HAPPENING IN ELECTRICAL SERVICES?

Highlights: A new 100-, 50- and 25-kvar capacitor line. A load-break switch that provides complete system and personnel safety. These examples demonstrate the extra value that is standard with Allis-Chalmers...the greater efficiency and added productivity that are yours when you buy A-C products, systems and services. Call your nearby Allis-Chalmers office for details or write Allis-Chalmers, Milwaukee 1, Wisconsin. A-1590

Metal-clad safety for your personnel... A roll-out load-break switch that completely isolates the switch from live current. Fuse changing and switch maintenance handled with maximum safety. The roll-out element cannot be withdrawn or returned to the cubicle with the switch in the closed position.

Load center substations cut costs! Ventilated dry-type transformers require less maintenance. You keep line losses at a minimum by locating substations close to your load centers. Other A-C advantages: a low-voltage breaker compartment that's completely isolated from bus compartment and other breakers; manual or electrical stored-energy closing; LCS units that are preplanned for expansion. Specify A-C substations with dry-type, oil-filled or *Chlorextol*-filled transformers.

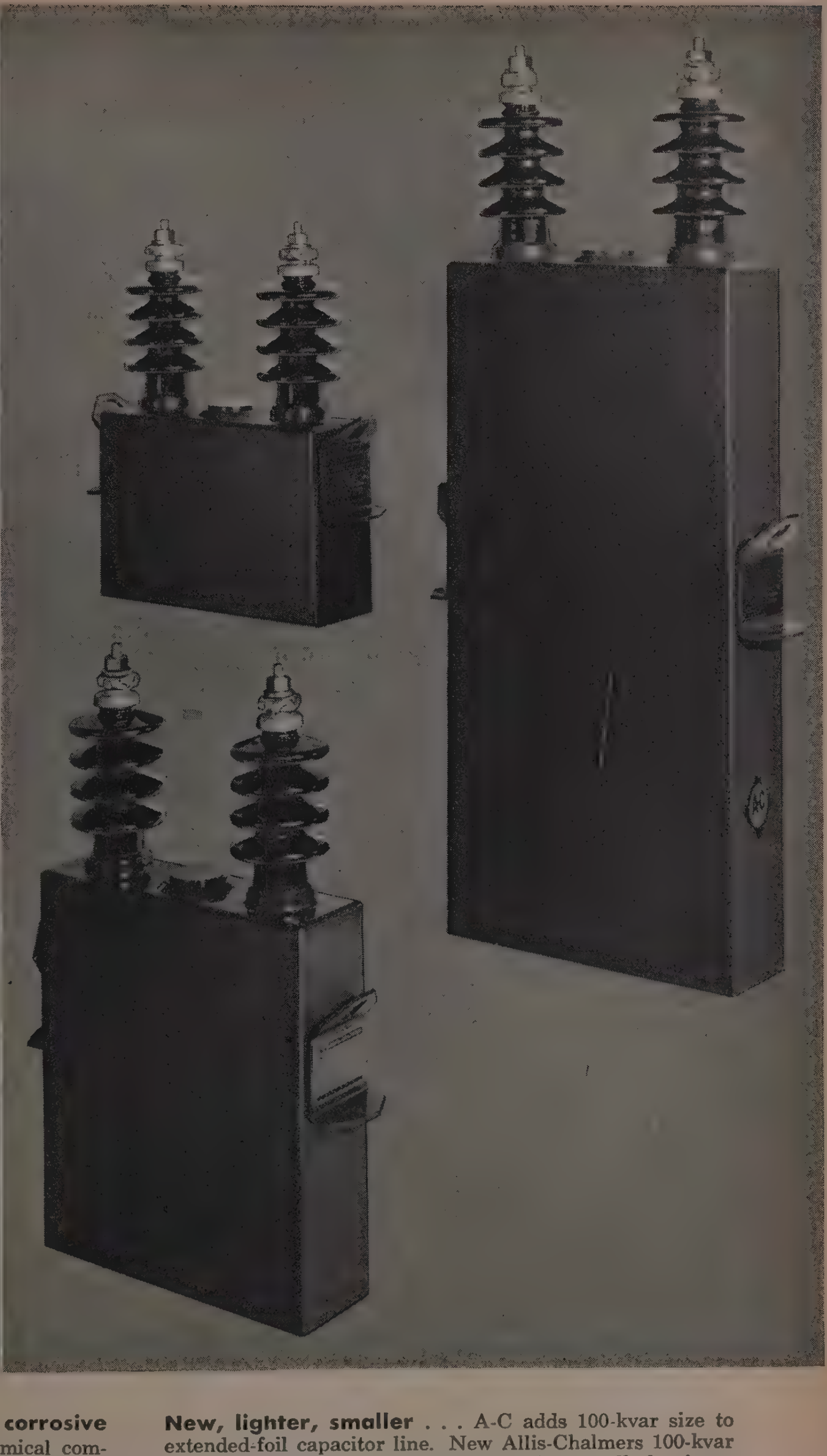
Chlorextol, Super-Seal, Paxeal and Vari-Tex are Allis-Chalmers trademarks.

▲

Dependable motor starters: Two years ago, A-C engineers traded the bulk in low-voltage motor controls for the savings of simplicity. With this came exceptional reliability, demonstrated by a substantial drop in the replacement parts business. You can be sure of fewer shutdowns when you specify A-C motor control—still the most advanced, easiest to maintain!

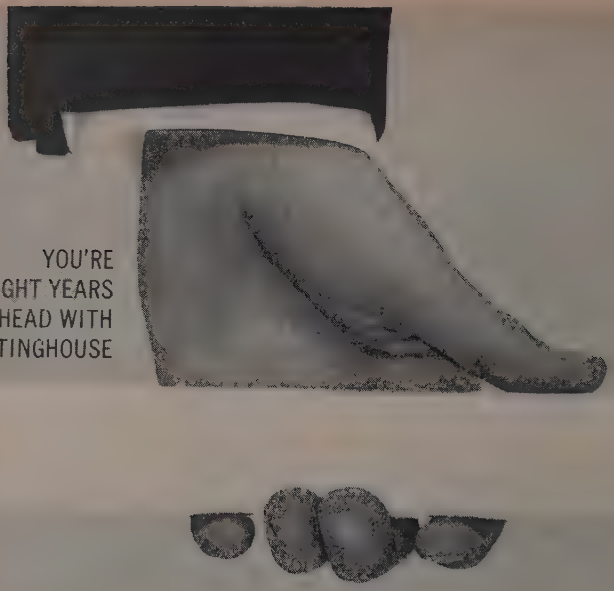
▲

***Vari-Tex* speed changer takes corrosive atmosphere in stride:** At a chemical company, this 25-hp *Vari-Tex* speed changer drives a pump through a single reduction gear unit. It operates in an atmosphere of hygroscopic potash dust which is highly corrosive when wet. *Poxeal* insulation system equips the open *Super-Seal* motor to deliver a long, trouble-free life.



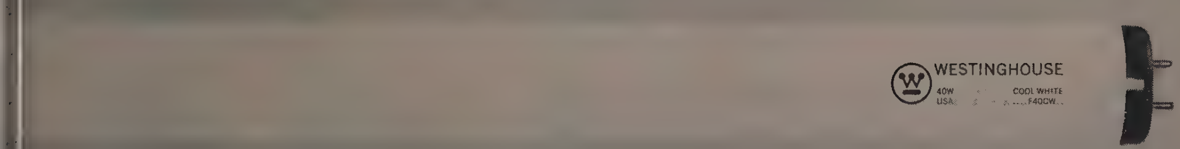
New, lighter, smaller . . . A-C adds 100-kvar size to extended-foil capacitor line. New Allis-Chalmers 100-kvar 95-kv-BIL capacitor weighs just 98 lb, has an all-aluminum case! To complement the new 100-kvar line, the 25- and 50-kvar units have been redesigned with aluminum cases, weights reduced to 37 and 58 lb respectively for 95-kv-BIL units. Mounting centers are still 15⅝ in. and case widths are 4 in. for all sizes from 2400 through 7960 volts.

ALLIS-CHALMERS


YOU'RE
LIGHT YEARS
AHEAD WITH
WESTINGHOUSE

If you are confused about current "lamp-life" and "lumen" claims...

READ THIS



This is our standard long-life fluorescent lamp.

It will do these jobs for you, most efficiently:

1. Give you light . . . all the light you need for normal working conditions. Good, clear, bright light.
2. Last a very long time. Its rated life span has been increased 60% to 12,000 hours.

This, incidentally, is a conservative figure. With normal 10-hour-a-day usage, it lasts even longer. For example, if you bought a long-life Westinghouse fluorescent lamp today, it would still be shining brightly for you at this date . . . in 1969.

In addition, this lamp fits all fluorescent fixtures. You do not have to overhaul your installation to use a Westinghouse long-life fluorescent. Another benefit: its long life can cut your lamp replacement labor costs as much as 37½%.

It is also sensibly priced. At $1.30, it costs no more than ordinary fluorescents.

To sum up: Westinghouse standard fluorescent is the longest lasting light of its kind on sale anywhere. Choose it if you are shopping for long-life fluorescent lamps.

or:

Where extra light is an absolute necessity, choose our new CROWN LINE Fluorescent. You get a full 3100 lumens for a rated life of 9,000 hours. Also, only $1.30 each.

In view of the superiority of these Westinghouse fluorescents, don't let the current "lumen" and "lamp-life" claims confuse you.

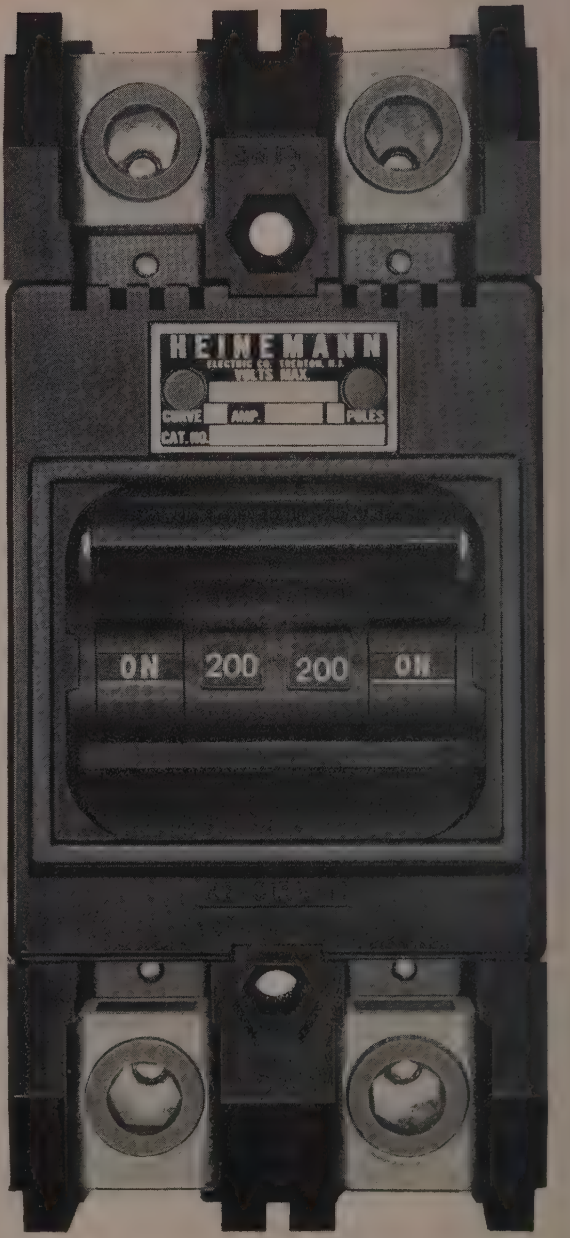
When you are buying light . . . any kind of light . . . simply remember: *You can be sure . . . if it's Westinghouse.*

Westinghouse

Westinghouse Lamp Division, Westinghouse Electric Corporation, Bloomfield, N. J

NOW...200-AMPERE CAPACITY IN ABOUT 50% LESS SPACE

Shown here, actual size, is Heinemann's SE-33 circuit breaker. It's about half the size of any other breaker that can be used for 200-amp service. • In a panelboard, it saves several inches. In its own enclosure (indoor or outdoor), it's more compact than equivalent fused safety switches or service-entrance pullouts. The SE-33 is the only 200-amp breaker built on a 200-amp frame (others use a 225-amp frame). This makes it smaller. And less expensive. It's also easy to install. Its terminals accept copper or aluminum conductors in the range of #6—#250, CM CU/AL. It has pressure-type solderless connectors. • The SE-33 is a two-pole breaker, available in ratings of 125, 150, 175, and 200 amperes, 120/240 V, AC. It always carries full-rated current because it's magnetically actuated. It never has to be derated for high ambient temperatures. All the details are in Bulletin 1003. We'll be glad to send you a copy.



HEINEMANN ELECTRIC COMPANY **132 BRUNSWICK PIKE, TRENTON 2, N. J.**

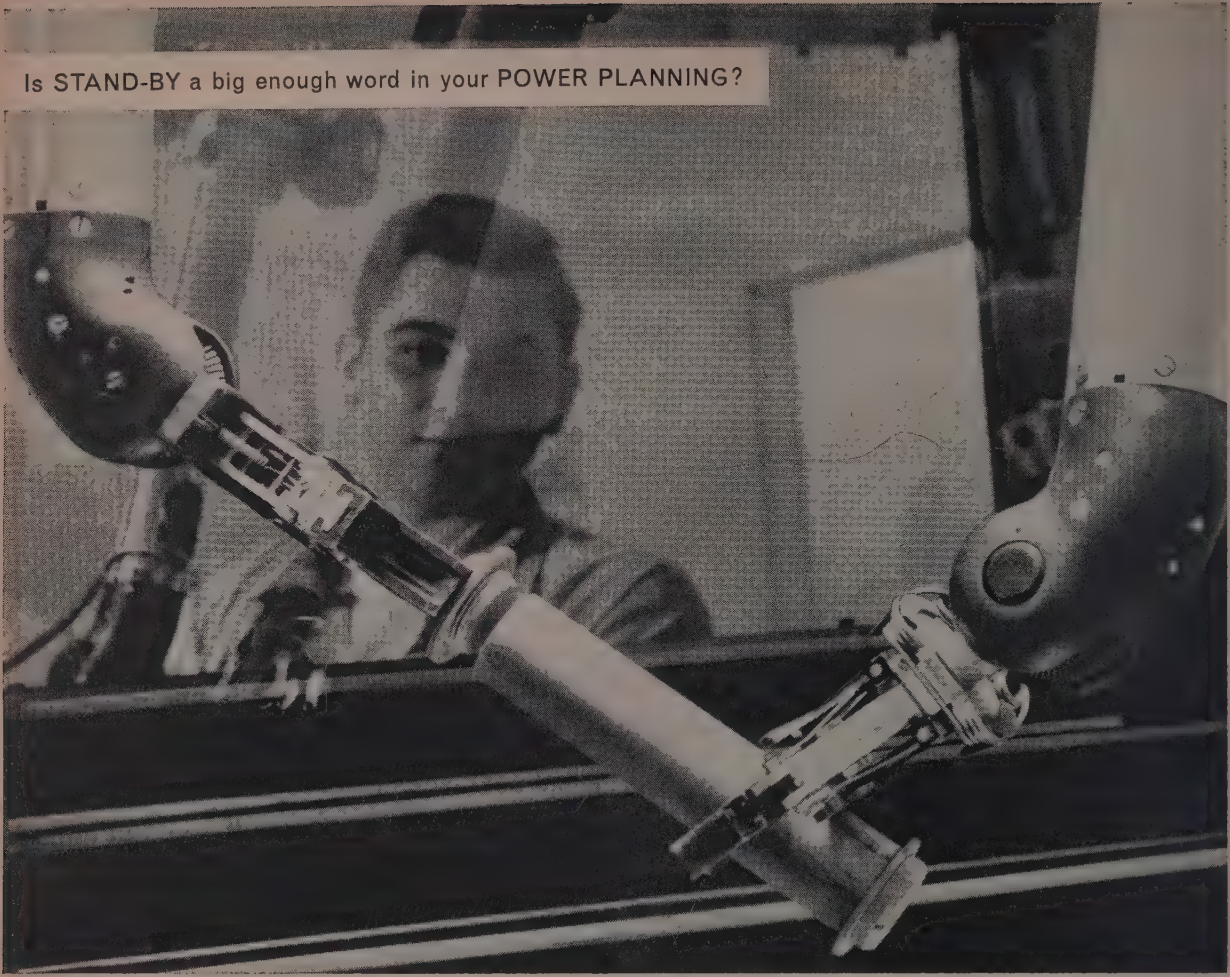
SA 2434

STEBER

YOU CAN'T PUT A ROUND PEG IN A SQUARE HOLE, BUT

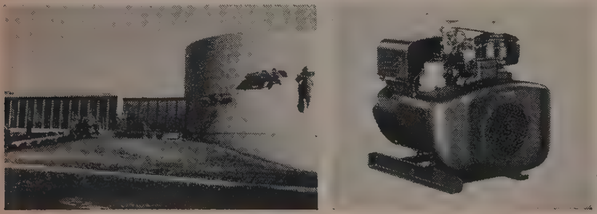
. . . you can produce the most efficient rectangular beam patterns at the lowest cost with the SPREADLITER mercury vapor floodlight. Efficient parabolic reflector design always gives higher light output than any other configuration. By taking the reflector directed light rays and bending them through prisms, the SPREADLITER produces rectangular beam spreads up to 164°. If your problem is to light an athletic field, parking lot, building or other large area, you'll be money ahead with SPREADLITERS. Write today for information.

STEBER DIVISION THE PYLE-NATIONAL COMPANY 2700 ROOSEVELT ROAD BROADVIEW, ILLINOIS


Is STAND-BY a big enough word in your POWER PLANNING?

These hands that must not fail depend on unfailing power

These nuclear research master-slave manipulators must not fail, cannot fail—and will not fail, even under the duress of electric power failure. Here, at Western New York Nuclear Research Center, in Buffalo, a Kohler 5 KW standy-by generator provides assurance against disaster due to power loss in nuclear experiments. The master control console, reactor tank ports and other major electrically powered facilities will receive power instantaneously from the Kohler stand-by plant in the event of sudden normal power loss.


New York Nuclear Research Center uses Kohler 5 KW stand-by unit

Kohler stand-by plants have proved their capacity to handle power emergencies in a routine manner in countless applications. In hospitals and schools, laboratories and industries, offices and commercial houses, adequate emergency-power planning has included Kohler plants. In planning reserve power needs, consider the toll exacted by power failure.

Full information on the many Kohler electric plants in sizes from 500 to 115,000 watts for stand-by (and sole) power use is available from your nearest Kohler Distributor. Or, write direct to the address below.

KOHLER OF KOHLER

Kohler Co., Established 1873, Kohler, Wisconsin

ENAMELED IRON AND VITREOUS CHINA PLUMBING FIXTURES • ALL-BRASS FITTINGS • ELECTRIC PLANTS • AIR-COOLED ENGINES • PRECISION CONTROLS

Cable's best friend

General Electric silicone rubber insulation protects against heat, overloads, ozone, aging, moisture and radiation

Double Capacity, Overload Protection — When used to insulate cable, silicone rubber gives you up to *twice* the current capacity, *twice* the overload protection as ordinary insulation. The superior electrical properties and wide operating temperature range of silicone rubber are the reasons.

Greater Reliability, Longer Life — G-E silicone rubber insulation has long service life at temperatures from −55°C to 200°C, and it is virtually ageless under severe conditions of heat, ozone, sub-freezing, moisture, and radiation. Trust it to keep working long after ordinary insulation fails.

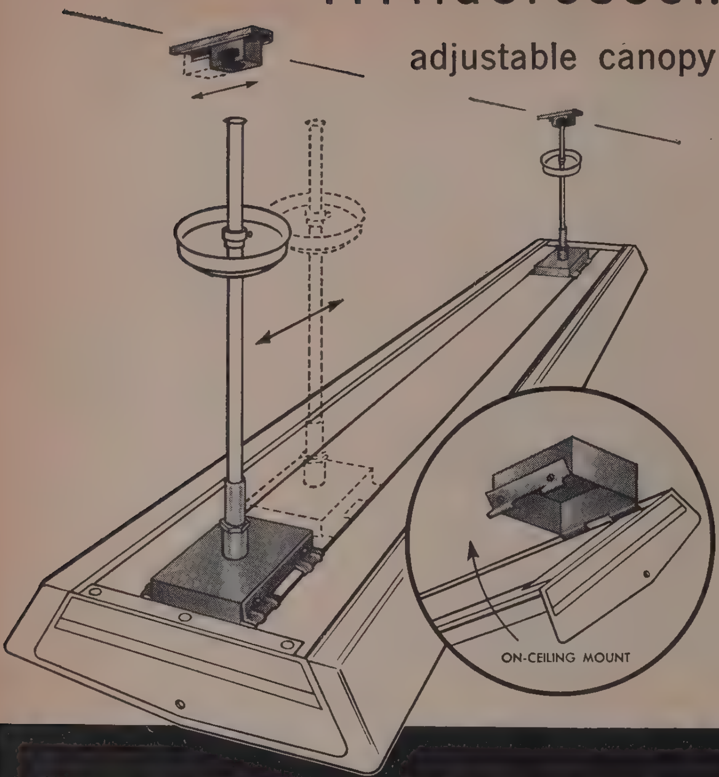
Possible Cost Savings! What's the price difference? More often than not, *none at all*. In old installations, use it in *existing* conduits. Capacity and protection goes up, costs go down. On new installations, you are buying the extra capacity and overload protection needed in the years ahead. Sound electrical insurance.

Get the full story on cable's best friend: silicone rubber. Write: General Electric Company, Silicone Products Dept., Section DD260, Waterford, New York.

GENERAL ELECTRIC

...fluorescent PHOTOMETRIC

adjustable canopy and sliding clamp hanger



Time saved is money saved. From the ceiling strap which permits lateral adjustment up to 1″ in either direction, the hook-on stem which makes one-man installation easy, the threaded stem which makes leveling the fixtures so simple, to the sliding clamp hanger which allows for final adjustments, Wakefield has developed a series of striking features to keep installation costs at a minimum. Note that the sliding clamp hanger is also used for on-ceiling mounting. If you are a Wakefield customer you *know*, if not, try Wakefield and be *convinced*.

Wakefield Lighting Division
VERMILION, OHIO
Wakefield Lighting Limited
LONDON, ONTARIO

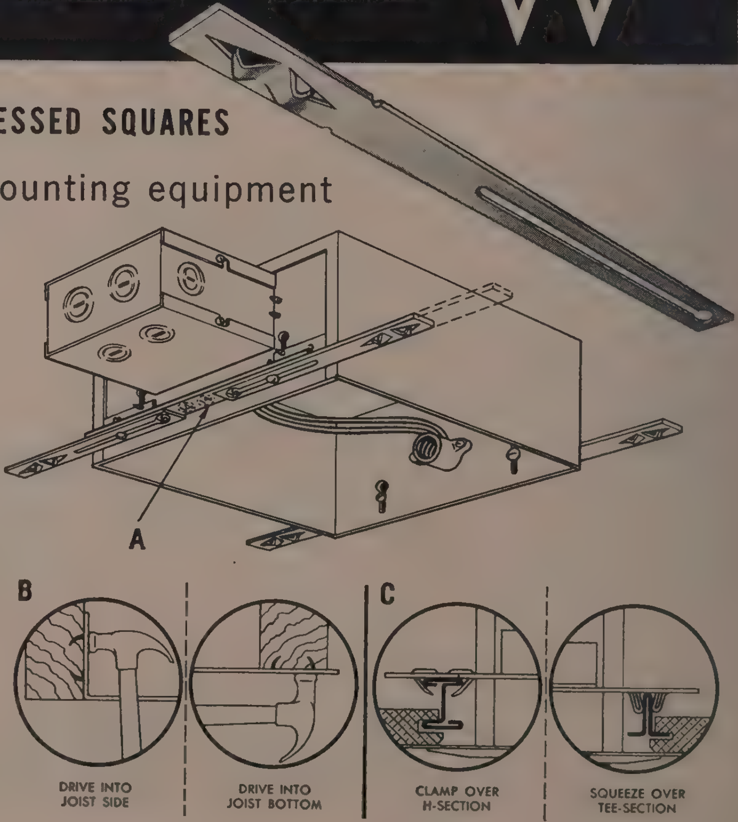
Time Saving Mounting Features by WAKEFIELD CORPORATION

...incandescent RECESSED SQUARES

clinch-cleat adjustable mounting equipment

Look at the illustration. Note that the side rails are stamped for pre-setting to either 14″ or 16″ joist centers (A). Next, you will see how the mounting bar provides for attachment to either the bottom or side of wood joists *without nails, staples or screws* (B). This is our famous Clinch-Cleat Attachment which also provides for mounting in acoustic tile mechanical suspension systems. The Clinch-Cleat clamps over H-sections or squeeze-fits over Tee-sections as shown in the sketches (C).

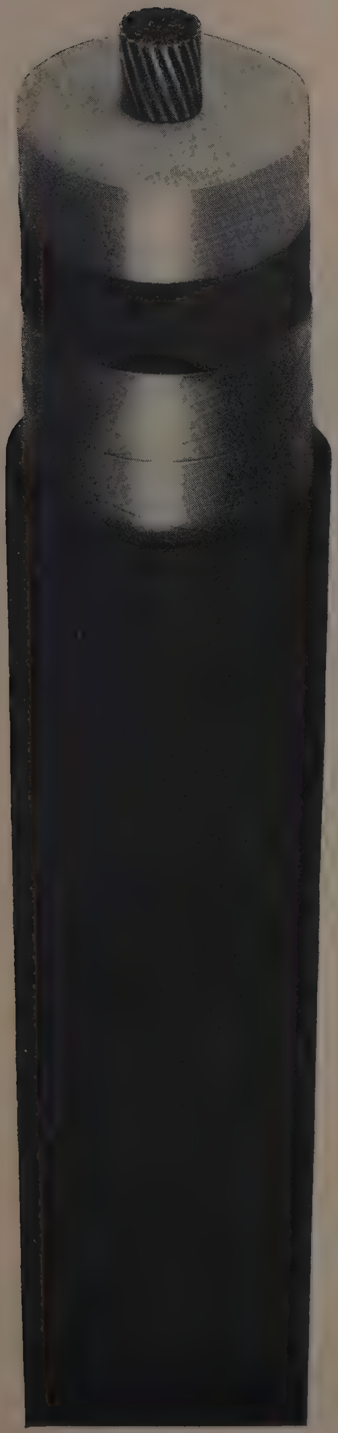
Art Metal Lighting Division
1814 EAST 40TH STREET, CLEVELAND, OHIO
Wakefield Lighting Limited
LONDON, ONTARIO



Here are five important questions . . . and their answers . . .
on an important new Simplex development in
electric power distribution and transmission

HIGH VOLTAGE POLYETHYLENE

INSULATED POWER CABLES



Q. *What are some of the advantages of Simplex polyethylene-insulated high voltage cables?*

A. Low dielectric constant (nearly 1/2 that of paper cables) . . . Low power factor (nearly 1/10 that of paper cables) . . . Low dielectric loss (nearly 1/20 that of paper cables) . . . Very high insulation resistance (at least 10 times that of paper cables) . . . High dielectric strength . . . (equal to paper cables).

Q. *What are some of the outstanding physical properties of Simplex polyethylene?*

A. Light weight (62% of paper cables) . . . High tensile strength (1800-2000 p.s.i.) . . . High elongation (400% minimum).

Q. *Where can Simplex polyethylene cables be used?*

A. In many places where rubber or paper cable is used. Typical installations are direct burial, duct or conduit, aerial and submarine.

Q. *What is the highest voltage at which Simplex polyethylene cables are rated?*

A. Simplex now has polyethylene cable rated as high as 46KV A-C. Development work now in progress is expected to extend Simplex polyethylene's voltage range to 69KV or higher.

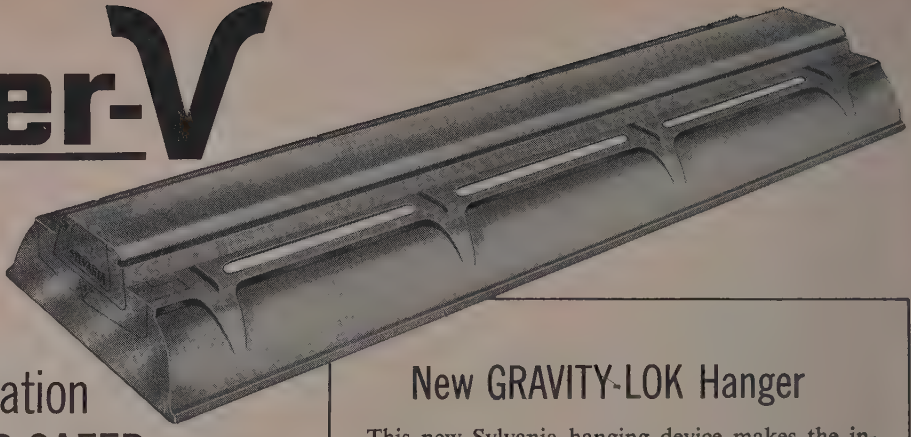
Q. *Has Simplex high voltage polyethylene cable been thoroughly field tested?*

A. Yes, as the leading producer of polyethylene cables, Simplex has in service more than 330 mile-years of polyethylene-insulated cable in the 5KV to 46KV range.

Send for complete information.

Simplex
WIRE & CABLE CO.
EXECUTIVE OFFICES: Cambridge, Mass.
Plants at Cambridge, Mass., Portsmouth, N. H., Westbury, L. I., Monrovia, Calif.

Sylvania's New Power-V Series



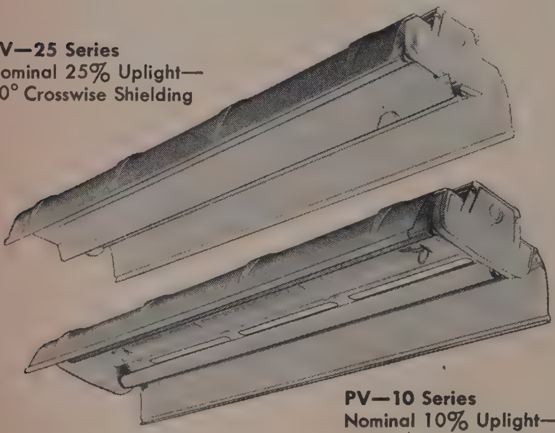
makes your Lighting Installation EASIER-FASTER-SAFER

Sylvania's new Power-V Series has been designed and built with you in mind . . . to provide money-saving methods of reducing installation time.

This, plus the built-in features of ruggedness, neatness, power, versatility and simplicity, make Sylvania Power-V the outstanding line of industrial fixtures available.

Ask your Sylvania representative or your Sylvania Select Distributor for details. Or write to:

SYLVANIA LIGHTING PRODUCTS
A Division of SYLVANIA ELECTRIC PRODUCTS INC.
One 48th Street, Wheeling, West Virginia

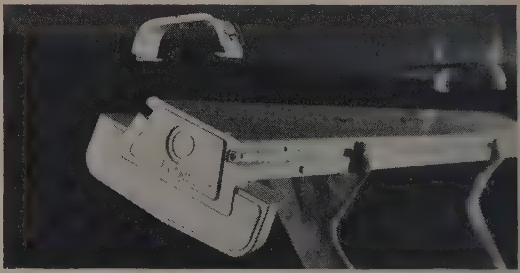


PV—25 Series
Nominal 25% Uplight—
30° Crosswise Shielding

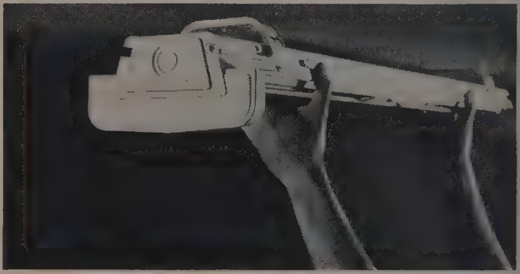
PV—10 Series
Nominal 10% Uplight—
13° Crosswise Shielding

New GRAVITY-LOK Hanger

This new Sylvania hanging device makes the installation of Power-V fixtures as simple as 1-2-3. Ask for a demonstration in your own office.



After Gravity-Lok Hanger is fastened or suspended, engage groove of one side of fixture channel into lip of stationary side of Gravity-Lok Hanger.



Rotate fixture into position. Movable clamp of Gravity-Lok Hanger moves aside as channel is pushed upward. Clamp then falls into groove on channel holding it in place. Then tighten screw on side of Gravity-Lok Hanger to prevent lengthwise movement of channel, when desirable.

LIGHTING FIXTURES BY

SYLVANIA

SUBSIDIARY OF

GENERAL TELEPHONE & ELECTRONICS

GENERAL SYSTEM

WIREMOLD® ELECTRIC IDEAS

PREPARED EACH MONTH FOR ELECTRICAL CONSTRUCTION AND MAINTENANCE
TO BRING IDEAS, NEWS AND HELPFUL INFORMATION TO ELECTRICAL MEN

63rd YEAR

FEBRUARY 1962

APPLIANCE DEMONSTRATION .... FIRST PAGE
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PRODUCT OF THE MONTH .... THIRD PAGE
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PRACTICAL TIPS .... FOURTH PAGE

Appliance Demonstration Simplified by Plugmold

Multi-outlet systems provide practicality for electrical appliance display areas

Versatile multi-outlet systems are boosting sales of electrical appliances by providing a practical touch to the displays.

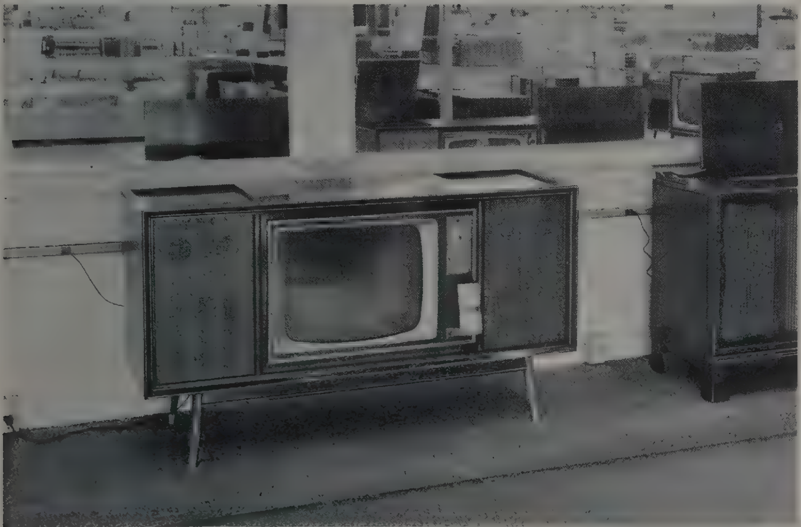
As one dealer observed, "Customers want to play the TV, radio, stereo or Hi-Fi before buying. This meant either moving the item to an outlet or connecting it to an extension cord that another customer might trip over.

"With the installation of Plugmold® in our store," he continued, "salesmen now can easily demonstrate any article on the floor because of the accessibility of outlets."

In this store, Plugmold was used in two main areas. One side of the store is devoted to the display of table radios and electric clocks. Here, the runs of raceway were mounted on a pegboard background above the shelves, permitting every radio to be plugged in.

Another area of the store is given over to larger appliances and the

continued on second page



TV AND STEREO sets have area of their own in this modern appliance department. Plugmold assures a receptacle for each set. TV antennae feed into Wiremold box.

Code Comments

Installing Multi-Outlet Systems

Q. *May multi-outlet systems be plastered-in?*

A. Certain multi-outlet systems may be plastered-in but this is limited by the Code to metal multi-outlet assemblies. Only the back and sides may be covered by the building finish. See Article 353-2 of the Code.

Telephone and Power Wiring

Q. *May telephone wiring and power wiring be run in the same raceway?*

A. Where both types of wiring are required in the same area, Wiremold recommends its Tele-Power system which provides not only separate raceways but separate covers for each run. See Section 800-3(a)(2) of the Code.

Baseboard Heating and Raceways

Q. *Can Plugmold be used above baseboard heating?*

A. Plugmold is often used above baseboard heating, as the proper location for Plugmold and baseboard heating are apt to be practically the same. The Plugmold, however, should be mounted in such a way that the temperature of the conductors never exceeds 140°F, as the Type TW wire used is limited to that temperature. It is generally good practice to separate the Plugmold from the hot radiator by a furring strip of wood to insure the temperature limit not being exceeded. See Section 310-4.

WIREMOLD®

Advertisement

Appliance Demonstration Simplified

continued from first page

multi-outlet system is located along the wall at chair rail height.

In the radio and television section of a leading department store, Plugmold is mounted on movable partitions, permitting the entire display area to be rearranged, or moved and set back up without major rewiring.

Another store owner has found that use of Plugmold makes it simple to frequently change displays with a consequent heightening of customer interest.

He explains that merely moving a few sets to a different shelf makes the display appear new. And, since every shelf is equipped with outlets, each set can be tested by the customer regardless of its location.

The flexibility of multi-outlet systems for displays has made it a virtual standard in many operations. One multi-store firm, for example, has specified that Plugmold be installed along every wall and along all display racks in the portable appliance department. Their reasoning, according to their engineer, is that by installing multi-outlet strips at the beginning, they have complete flexibility when special displays or promotions are to be set up.

Generally, Plugmold 2000 is specified for this type of application. Outlets are set fairly close together so that the display area can be used for appliances of different widths. Also, many engineers feel it is best to hold to rather close spacing to assure flexibility.

In special applications, Plugmold 2100 frequently is used and, where an unusually large number of circuits is required, Plugmold 3000 may be called for.

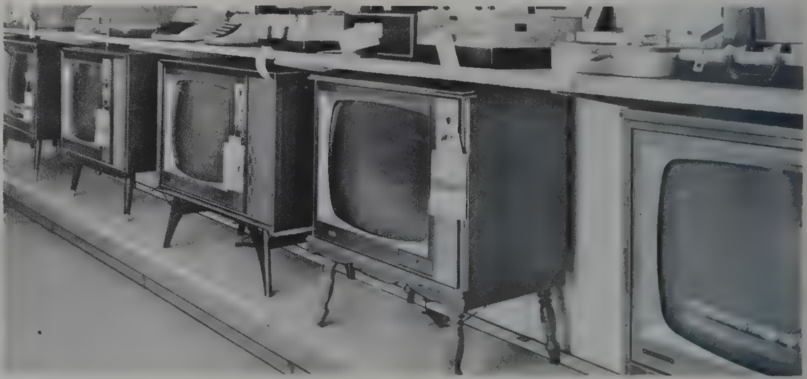
Additionally, Plugmold has the advantage of blending with the decor of the area when painted. This almost-invisible quality of the system enhances the decorative effect recognized as being important in modern merchandising.

Frequently, multi-outlet systems are used in stores for such other purposes as wiring for lighting, packaging, etc.

WIREMOLD®

CUSTOMERS can turn on television sets by themselves since each is plugged into outlet in Plugmold strip. Grounding type receptacles are used.

SPECIAL CONDITIONS made it advisable to use Plugmold 2100 for this radio display. Although most installations use 2000, any series can be used to obtain flexibility.



MULTI-OUTLET strip adds practicality to appliance display in this modern discount store by eliminating need to move set for customer demonstration.

WIREMOLD ■ HARTFORD 10, CONN. E2-2

Gentlemen: Please send free the checked items

NAME ____________________

COMPANY ____________________

ADDRESS ____________________

☐ New Wall Chart

☐ Electric Ideas, January 1962

☐ Electric Ideas, December 1961

☐ Wiring Guide (Catalog 22)

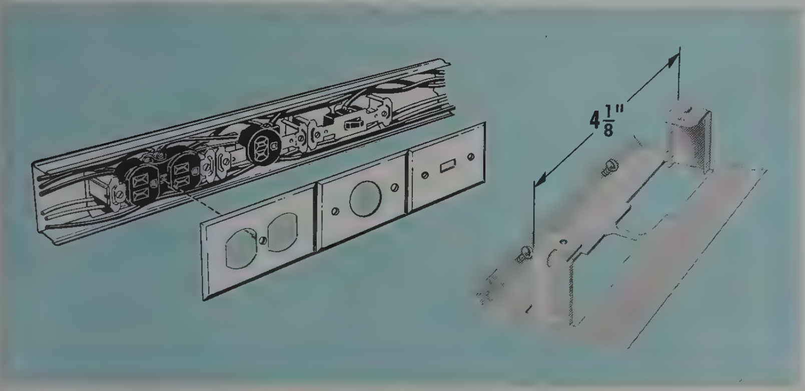
Advertisement

Product of the Month

Devices mounted in 3000 by means of bracket

Any number of standard devices may be mounted directly in Wiremold 3000 through the use of the 3007C Device Bracket. Standard flush plates are used, eliminating the need for outside clips.

The 3007C may be snapped in anywhere along the raceway. Where two lengths of raceway butt, the device also serves as a coupling and as an effective means of providing continuous grounding.

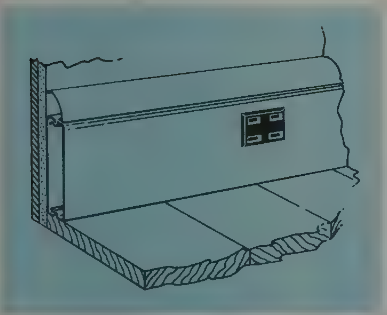


Quiz Corner

Questions for this department are taken from inquiries received from the field. Your questions are welcome; indeed, they are necessary if this department is to serve you with worthwhile information. Address:

Quiz Corner
The Wiremold Company
Hartford 10, Conn.

Q. *Can I get a trim mold for Plugmold?*



A. Yes. In place of wood quarter-round, Wiremold offers Plugtrim® 1900T which may be used as a trim alone or as a channel for telephone cables. Capacity is 16 pair telephone cable.

Q. *Can Wiremold 2100 be used for group branch circuits?*

A. Yes. The 2174 Take-Off Connector provides a simple means to feed branch runs of 500 or 700 Wiremold and the 2186 Adjustable Offset Connector provides direct connection of 2100 to surface panel with full wire capacity of the raceway (14 No. 12 conductors).

Q. *In rewiring a school, we are planning to use Wiremold 500 in the classrooms. Would it be practical to use 2100 for feeders down the halls? The halls have several offsets.*

A. Yes. 2100 has a capacity of 14 No. 12 conductors, and the 2117TC (internal) and 2118A (external) elbows make it extremely easy to go around the offsets with a minimum of fastening.

Q. *How do I protect Wiremold when passing it through a floor?*

A. Use Wiremold kick plate—5787 with 500 or 700; 1087 with Wiremold 1000.

Noteworthy

Key to Catalog

Items listed in the Wiremold Catalog are systematically numbered to facilitate the selection of the proper tool, fitting or device for the job.

These parts are identified by a three, four or five digit number. The last two digits describe the fittings while the first ones identify the series. Thus, 517 is an internal elbow for use with the 500 series (the 17 denotes an internal elbow whether it is a 1917, 1517, or 517); 5719 is a corner box that may be used with either the 500 or 700 series; 57242 is a utility box that can be used with the 500, 700 or 200 series. Again, a 1942 is a junction or utility box for use with the 1900 series.

With multi-outlet systems, the first two digits indicate the Plugmold system, the next letter indicates type of outlet, the next two digits, the outlet spacing. Example: 22S18 indicates 2200 Plugmold Snapicoil® with three-wire duplex outlets wired 18-in. on centers. Factory-wired sections follow the same system except that *three* digits follow the letter and indicate length of strip and spacing of outlets. Example: 20G618 indicates Plugmold 2000 Wired Section 6-ft. long with two-wire grounding outlets spaced 18" on centers.

Variations are covered in the Catalog and Wiring Guide.

Personnel at Meetings

Harlan Schendel, Minneapolis, and John Britt, home office, will be at the Upper Midwest Electrical Trade Exposition at the Minneapolis Auditorium, Feb. 18-20, while George Gray, San Francisco, will represent Wiremold at the Progress in Electrical Equipment Exhibit at the Sacramento (Calif.) Inn, Feb. 28-March 2.

Harlan
Schendel

John
Britt

George
Gray

WIREMOLD®

Advertisement

Engineered Specials

Special 2100 lumiline lighting fixture for electronic cabinet

PROBLEM:

To provide a single source of illumination for reading the dials on newly designed electronic equipment located in metal cabinets.

SOLUTION:

A 2100 lumiline fixture with reflector was wired with jacks to allow the technician to plug in the unit in any one of the four positions inside the cabinet.

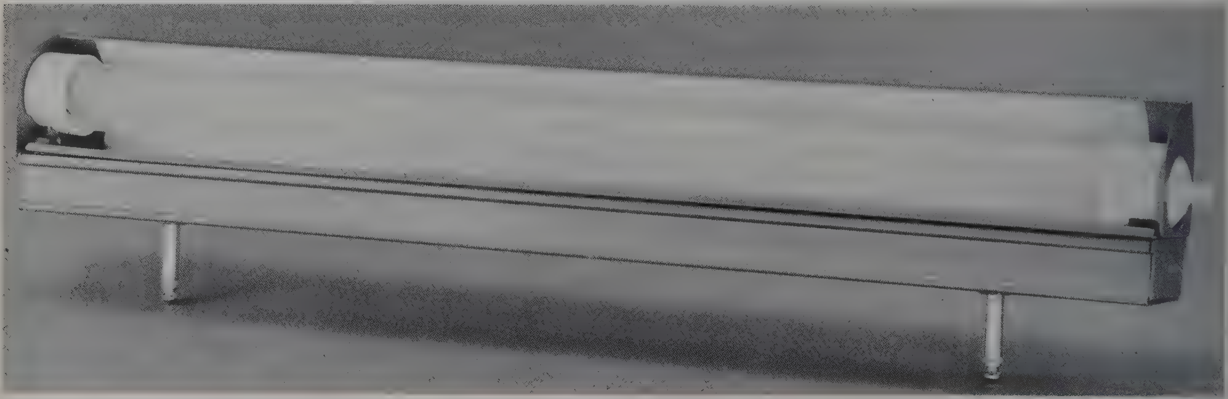
DISCUSSION:

A lighting problem interfered with a new design for installing electronic equipment in a metal cabinet, similar to a four-drawer letter file cabinet. For the technicians to work with the equipment, it was imperative that they have ample light to read the various dials and gauges. It was further necessary to have light in the four positions in which the equipment was installed.

Wiremold 2100 was factory-wired to serve as a fixture for a lumiline lamp with reflector. Jacks were fitted to the underside of the raceway.

This allowed the plugging-in of the light, by means of the jacks, at the desired locations in the cabinet. By this approach, it was possible to use one design in all four locations.

Wiremold engineers are pleased to assist in the solution of design problems by making special adaptations of the product line.



Useful Literature

Check coupon on second page for copies of listed items.

New Wall Chart

A new, quick-reference wall chart, showing Wiremold raceways, fittings and accessories for power and light wiring, is available without charge to distributors and electrical contractors. The 28 x 42-in. sheet pictures Wiremold surface wiring raceways, Pancake® overfloor raceways, Plugmold multi-outlet systems, and Wiremold tools and fittings designed for use with these products. The two-color chart is plastic coated for greater durability.

The dimensions, wire capacities, catalog numbers, and nomenclature of these items are displayed in over 400 illustrations.

Practical Tips

One-piece raceway simplifies wiring

Wiremold one-piece raceway is a simple, efficient and inexpensive method of wiring.

Consider the ease of installation of this surface-mounted wiring system. The base and capping of the raceways are factory-assembled, making it possible for the electrician to do a better job at less cost than is possible with field assembly. Because it is one piece, it is easier to handle, especially for overhead installation.

A large part of the job of fastening the raceway to the surface is done at the joints through the coupling provided with each length; additional support is obtained, where needed, by the use of Wiremold clips. These clips are fastened to the surface and then the raceway simply is pressed into the clip. Where concealment is not important, mounting straps may be used.

Wiremold installations are a visible testimony to the craftsmanship of the electrician.

WIREMOLD®

HARTFORD 10, CONNECTICUT
In Canada: Conduits National Co., Ltd.
Toronto 2, Ontario

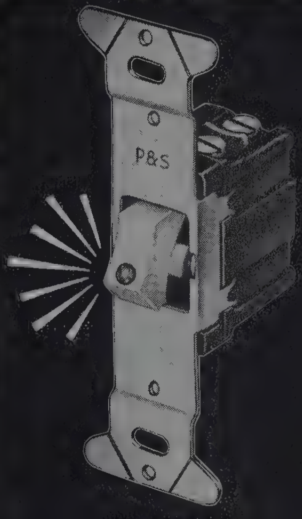
All WIREMOLD products are sold through electrical distributors — your best source for all electrical products.

Advertisement

NOW! 3 NEW *P&S ROCKER-GLO SWITCHES!*

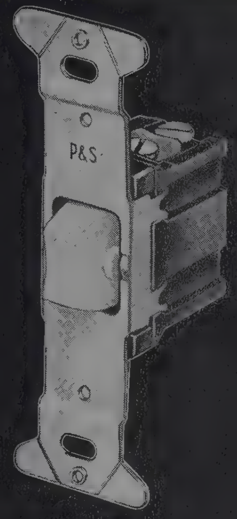
No. 2211-SL

No. 2211-SL also available in strap type No. 2221-SL



No. 2221-SP

No. 2221-SP also available in Despard (interchangeable) type No. 2211-SP



No. 2225-S

No. 2225-S also available in Despard (interchangeable) type No. 2215-S

1

LIGHTED HANDLE ROCKER-GLO

Pinpoints switch location in darkened rooms or hallways. Tiny, long-life neon lamp softly glows in OFF position only. Single pole or three-way. Rating: 15 Amperes, 120 Volts, A.C.

2

Pilot Light HANDLE ROCKER-GLO

Instantly shows when appliances or lights are on. Tiny red plastic jewel in rocker button lights in ON position only. Single pole only. Rating: 15 Amperes, 120 Volts, A.C.

3

REMOTE CONTROL ROCKER-GLO

Momentary contact, center "off" switch. Designed especially for low voltage remote control applications—controlling large banks of lighting, operating stage curtains, etc. Single pole, double throw. Rating: 10 Amperes, 48 Volts, A.C.

For more information write Dept. ECM262

P&S PASS & SEYMOUR, INC.
SYRACUSE 9, NEW YORK
1440 N. Pulaski Rd., Chicago 51, Ill. In Canada: Renfrew Electric Co., Ltd., Toronto, Ontario

HOW ELSE
SHOULD YOU
MEASURE A
MOTOR STARTER?
CONTROL
CUTLER-HAMMER
RESET

CONTROL

WHAT DO CONTRACTORS SAY ABOUT MOTOR STARTERS?

"Sure, quality and performance are essential, but other factors often determine our choice."

Important to be able to pick up the right motor starter when you want it? You said it! It's the only way a contractor can stay in business.

And in a recent study, 254 typical and important buyers of motor starters told Cutler-Hammer just *how* important.

As you'd suspect, the contractors and their customers wouldn't even consider a motor starter that doesn't deliver top performance in reliability, quick installation, easy maintenance, long contact life and so on. And these are standards in which Cutler-Hammer starters have long excelled.

But, said these contractors . . . there's much more to the story. More than half the time, they or their customers chose between motor starters on certain *non-product* measurements.

1. AVAILABILITY

Local stocks are considered a must by buyers. And with Cutler-Hammer, more than 600 distributors maintain balanced stocks. Complete starters or required replacement parts are just a phone call away. They're backed up by 66 district offices and 17 regional warehouses. The 91% of your motor starter requirements that you need in a hurry are available *locally*. Even special requirements can often be handled overnight.

2. SERVICE

Service was the next most-mentioned factor. And you'll find Cutler-Hammer service better than ever. Both the distributor and the Cutler-Hammer man will treat your problem as their own. Together they'll be able to handle your problems—and emergencies—in just hours.

3. COMPLETE LOCAL STOCKS

Being able to get the right starter when needed naturally ranks high in importance with buyers. With Cutler-Hammer, you get exactly the starter you need to do the job right. Cutler-Hammer has 10 NEMA sizes, 00 through 8.

For complete details on a starter line designed to industrial standards, proven in thousands of applications and exceeding NEMA requirements in every respect, send for publication LO-70-C241.

So next time you're talking about motor starters . . . talk to Cutler-Hammer. You know the reputation of our products . . . call your nearby Cutler-Hammer distributor and find out about his service!

WHAT'S NEW? ASK...

CUTLER-HAMMER

CONTROL

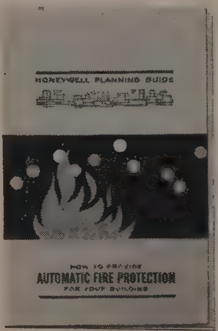
Cutler-Hammer Inc., Milwaukee, Wisconsin • Divisions: AIL; Mullenbach • Subsidiaries: Uni-Bus, Inc.; Cutler-Hammer International, C.A. • Associates: Cutler-Hammer Canada, Ltd.; Cutler-Hammer, Mexicana, S.A.

Fastest fire detector...

Free! Building System Planning Guides for

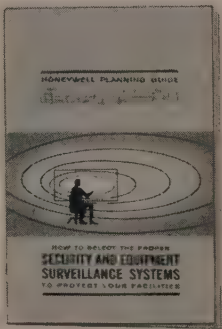
Four, new, authoritative guides designed to help you advise your clients on how to get the best electrical systems when they build or remodel. Guides cover new techniques and developments. They help your clients avoid early obsolescence and high maintenance costs. Point out the advantages of a quality installation. They give you new background information. And they're all from Honeywell—the only company that designs, builds, installs and guarantees all these building systems.

Mail the coupon now for your Planning Guides. Check them all if you wish.



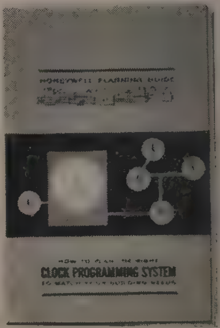
AUTOMATIC FIRE PROTECTION

Explains principles, different automatic systems, best way to protect lives, property.


HONEYWELL PLANNING GUIDE
HOW TO SELECT THE PROPER
SECURITY AND EQUIPMENT SURVEILLANCE SYSTEMS
TO PROTECT YOUR FACILITIES

SECURITY AND EQUIPMENT SURVEILLANCE SYSTEMS

Covers different ways to protect against intruders plus equipment monitoring.



CLOCK PROGRAMMING SYSTEMS

Gives advantages of system for different types of buildings, new developments.

Honeywell Smoke Sentry*!

Smoke Sentry matched against all major types of fire detectors by Los Angeles Fire Department. Sounded alarm first in 8 out of 10 fires.

Acting under the supervision of the National Fire Protection Association, the Los Angeles Fire Department set a total of 102 fires in the condemned school shown at left.

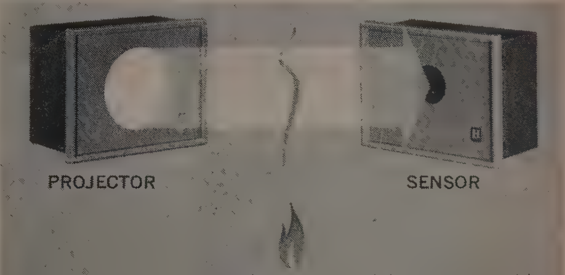
Chief purpose of one series of tests was to measure the response time of automatic fire detectors. In 8 out of 10 of these tests, Honeywell's Smoke Sentry was the *first* to detect fire. And in one test, involving a near explosive-type atmosphere, the Smoke Sentry triggered the alarm just one second after the fire was started.

Why such unusually fast response? Honeywell's Smoke Sentry isn't actuated by what can be a relatively slow increase in room temperature. It detects smoke . . . the first sign of fire!

Despite its extreme sensitivity, a built-in time delay eliminates false alarms that could be caused by an object, such as the top of a ladder, passing through its watchful beam. And the Smoke Sentry can be set for different densities of smoke to protect different types of areas.

We suggest you investigate Honeywell's Smoke Sentry for your jobs. It gives your customers a vital extra margin of safety . . . yet it costs no more than many other types.

Your nearest Honeywell Office will be glad to furnish complete information at no obligation. Or, if you prefer, mail the coupon below for the Planning Guide on "Fire Detection and Alarm" plus any others you would like. *Sales and service offices in all principal cities of the world.*



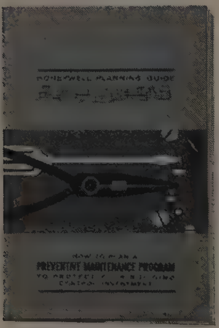
BEAM-OF-LIGHT SMOKE DETECTION. Smoke Sentry sounds the alarm fastest, adds extra life-saving minutes for evacuation time. Basic unit consists of a projector and a sensor. In large installations, an annunciator panel is used to pinpoint fire location

* UL Approved

Honeywell

H HONEYWELL *First in Control*

your clients



PREVENTIVE MAINTENANCE PROGRAMS

Tells ways maintenance can cut costs. How to make sure client's program is adequate.

CHECK GUIDES YOU WISH. MAIL COUPON

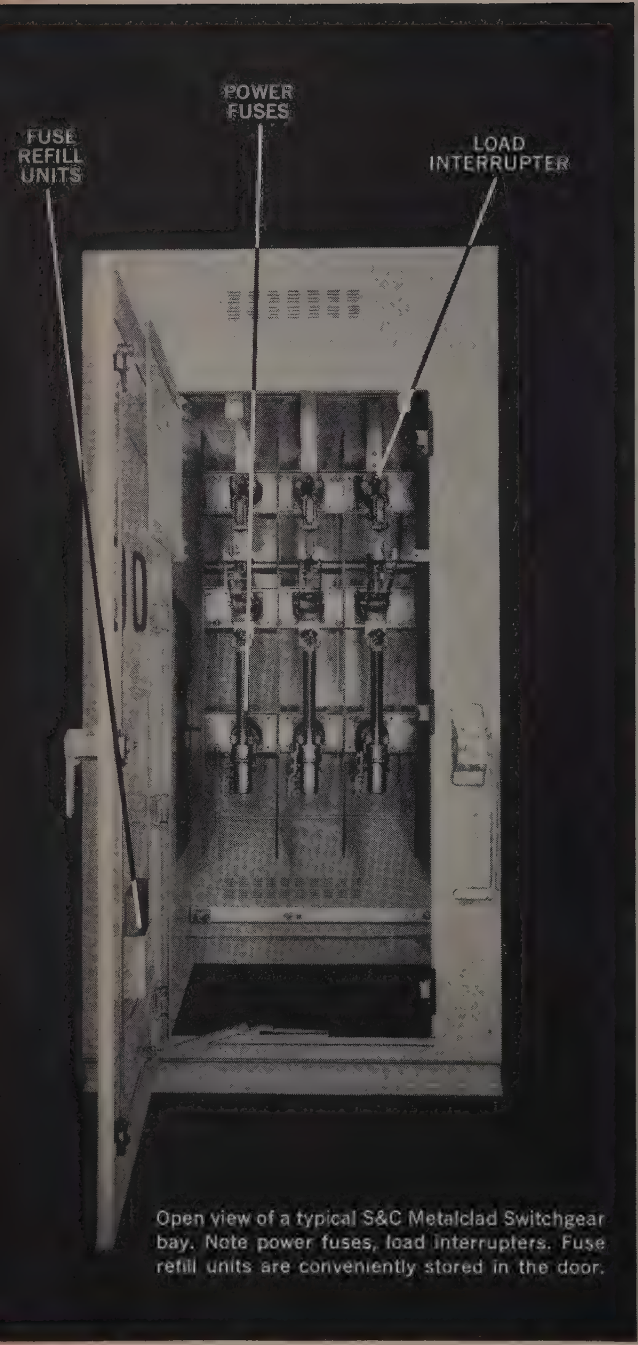
To: Minneapolis-Honeywell, Dept. EC2-66
2753 Fourth Ave. South, Minneapolis 8, Minn.

Please send me the following Planning Guides.

☐ Automatic Fire Protection ☐ Clock Programming Systems
☐ Security and Surveillance ☐ Preventive Maintenance Programs

Name ____________________
Company ____________________
Address ____________________
City ____________ Zone ______ State ____________

The 500,000-kva "compact"



Open view of a typical S&C Metalclad Switchgear bay. Note power fuses, load interrupters. Fuse refill units are conveniently stored in the door.

S&C Metalclad Switchgear provides maximum protection in a minimum of space

1. Compact construction. 2. No need for rear access. 3. No front drawout. These features permit S&C Metalclad Switchgear to be installed against walls, in corners, along passageways, even in vaults and on balconies too small to accommodate circuit breaker type gear.

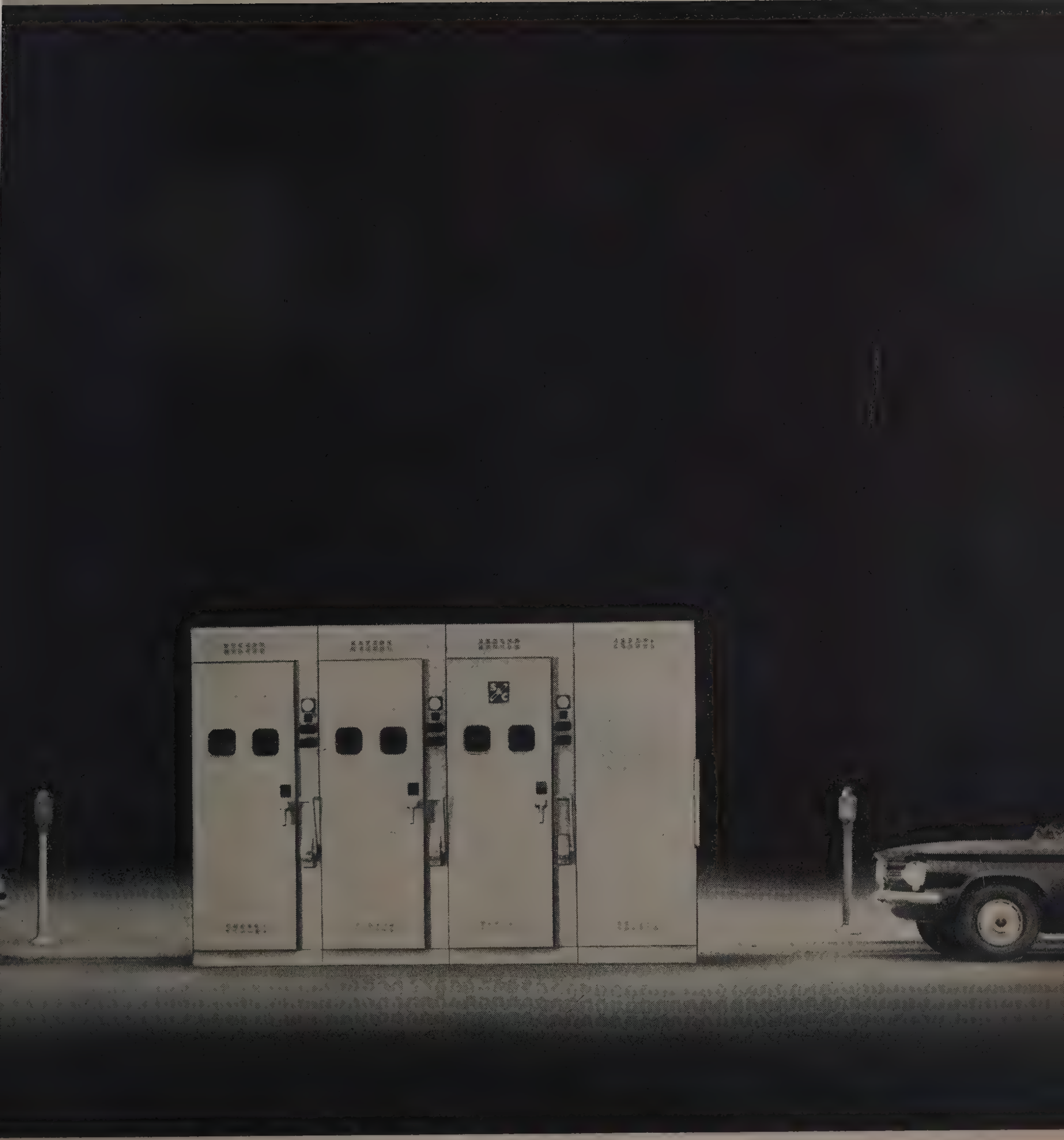
Unlike expensive circuit breaker type switchgear, S&C gear with fused load interrupters requires no exercising, periodic checkouts, or adjustments. S&C Metalclad Switchgear is as economical on maintenance as on space.

These advantages result from the simplicity of the S&C design, which uses power fuses for short circuit protection and load interrupters for manual or automatic load switching. Power fuses give the protection needed against permanent destructive faults. Since industrial and commercial high voltage circuits are not subject to transient faults (such as lightning, falling trees, ice, rodents), they don't need the costly repetitive and automatic reclosing features of the circuit breaker.

Compact S&C Metalclad Switchgear is available for indoor and outdoor service, with short circuit interrupting ratings up to 500,000 kva at 13.8 or 14.4 kv, and 250,000 kva at 4.16 kv (with fault closing ratings to match). Continuous current ratings are 200, 400, 600, and 720 amperes with fuses, and 1200 amperes without fuses (with load switching ratings to match). Further details are available from any S&C sales office, listed in the Yellow Pages (under "Electrical Equipment"). Or write to:

S&C OUR GOLDEN JUBILEE

S&C ELECTRIC COMPANY
6605 Ridge Boulevard • Chicago 26, Illinois
Specialists in High Voltage Circuit Interruption since 1911



S&C Metalclad Switchgear meets all National Electric Code requirements for fault closing, short-circuit interruption. Performance proved by high power testing at KEMA laboratories.

FROM PORTLAND TO PUERTO RICO ENGINEERS & CONTRACTORS PREFER SORGEL

From coast-to-coast more and more leading consulting engineers, plant engineers and contractors are specifying and insisting on Sorgel quiet-quality dry-type transformers. They recognize the true value of economy through quality features such as these:

- In Quiet-Quality units, performance data, such as core loss, copper loss, sound level, etc., is always equal to, or lower than, the guaranteed values submitted to the customer.
- Sorgel units are individually tested in accordance with NEMA standards. Certified tests are furnished upon request, to further substantiate the guaranteed data.
- All coils have end filler protection in each layer to prevent movement of conductors under heavy loads and short circuit stress conditions.
- The transformer core and coil unit is specifically designed for low sound level. In units 15 KVA and larger, the core and coils are mounted on vibration dampening pads designed to suppress transmission of vibration to adjacent areas.
- All terminations are securely anchored, and solderless connectors are furnished on all transformers with terminal boards. Vacuum impregnated windings are brazed to the terminals.
- Connection covers are cushioned and easily removed by means of two captive bolts on small sizes, and four on larger sizes.

It's Sorgel advantages like these that protect your electrical distribution systems from failure, assure continuity of operation and maximum efficiency at all load conditions. You can always count on Sorgel units to perform as guaranteed. This carefully engineered economy through quality is the soundest reason of all for you to specify and insist on Sorgel dry-type transformers.

SORGEL
SOUND-RATED DRY-TYPE
TRANSFORMERS

SORGEL ELECTRIC COMPANY
Since 1916 the pioneer in the development, manufacturing
and application of sound-rated dry-type transformers
836 WEST NATIONAL AVENUE • MILWAUKEE 4, WIS.
Experienced sales engineers in principal cities

PORTLAND

Engineering group out west studies recently installed 112½ KVA Sorgel unit in Tektronix's main facilities at Beaverton, Oregon. Contractor commented on the fast installation of Sorgel units because of easy accessibility to terminal connections. Contractors claim Sorgel units are the easiest to install, best operating they have ever seen.

CHICAGO

This team was responsible for the installation of these 112½ KVA units in Chicago's Morton Salt Building. They provide continuous electrical service for one of the nations largest electronic computers. Sorgel built-in quiet-quality provides extra margin of safety.

the Symbol of Specialization

PUERTO RICO

Sorgel equipment serves internationally. This unit substation is installed in a psychiatric hospital in San Juan, Puerto Rico. It provides power for all electrical needs, lighting operating rooms, office electrical equipment, and utilities. Reviewing the installation are Mario Franceschini, Sorgel Engineering Representative, Ruben D. Reyes Electrical Engineer and Contractor, and maintenance man Modesto Aponte.

LAUDERDALE

Quiet level of operation plus ease of installation are two of the many big advantages of this Sorgel 30 KVA unit recently installed in new Broward County Court House, Ft. Lauderdale, Fla.

This emblem means real advantages to you

. . . on a lighting fixture ballast

1. Longer lamp life . . . up to 12 months longer

2. Longer ballast life . . . long trouble-free operation under normal conditions

3. Positive starting . . . plus power factor correction, UL listing

4. Full light output . . . assures rated light from fluorescent lamps

. . . these practical advantages and others grow out of *specified performance.* Certified CBM Ballasts are produced by leading manufacturers to meet rigid specifications . . . set by ASA and checked by Electrical Testing Laboratories. Good reasons why it pays to be sure of Certified CBM Ballasts in fluorescent fixtures that you specify or install. For helpful news and facts on ballasts, ask us to send you CBM News.

CERTIFIED BALLAST MANUFACTURERS
2116 Keith Building, Cleveland 15, Ohio

Participation in CBM is open to any manufacturer who wishes to qualify.

1-62

To make Leviton wiring devices available to you everywhere, your order is prepared electronically by a system of data processing machinery that – through a national communications network – feeds it to one of 10 regional warehouses. Leviton's fleet, with a daily shipping capacity of over 350 tons, moves your order from 1,000,000 sq ft of stock – to give you what you want, when you want it and where you want it.

Catalog #5521 ■ Quiet Switch 20A.277V. A.C. only ■ Underwriters Laboratories, Inc. Inspected

One of LEVITON's 60 types of switches

LEVITON MANUFACTURING CO., INC., BROOKLYN 22, N. Y. ■ Chicago ■ Los Angeles ■ Montreal, Canada
Contact AMERICAN INSULATED WIRE CORP., Pawtucket, Rhode Island, A Leviton subsidiary, for a complete line of insulated wire and cable products.

LEVITON

Super-Seal motors came through where other types of motors failed:

Dow Badische Chemical Company
Technical Service Laboratories
Engineering and Construction Services Division
DOW
DOW

Hurricane "Carla" dumps 5 feet of all but one start up without

Only a quick servicing in place to get 'em running and help put Dow Chemical on stream in ten days

WHEN HURRICANE CARLA battered the Gulf coast last fall, it flooded the huge Dow Chemical Company complex at Freeport, Texas. Right in the thick of things were over 600 *Super-Seal* motors, under four to ten feet of seawater and silt for as long as four days.

After the flood receded, 524 out of 525 *Poxeal* encapsulated *Super-Seal* motors were returned to service with minimum maintenance. They did not have to be removed to service shops for bakeout. Relubrication together with some washing and drying in the field was all that was required.

The one *Poxeal* encapsulated motor that required bakeout? It was accompanied by over 3000 TEFC and explosion-proof motors with Class A insulation.

Also, more than 75 *Super-Seal* motors, between 75 and

seawater on 600 Super-Seal motors; need for bakeout

1500 hp, with *Silco-Flex* insulation systems were flooded. None of these had to be removed from the plant because of insulation failure.

Allis-Chalmers was first to introduce the concept of open motors with special protection for the stator windings. For more than five years — in the laboratory and in the field — *Super-Seal* motors with revolutionary *Poxeal* and *Silco-Flex* insulations have been proving their ability to shrug off water and dirt, as well as acids, alkalis, oils, dust and other contaminants.

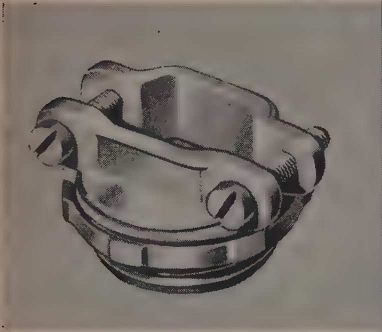
Get the added insurance against downtime that *Super-Seal* open motors can provide. Call in your A-C representative or distributor; ask him for all the facts. Or write Allis-Chalmers, Milwaukee 1, Wisconsin.

Super-Seal, Poxeal and Silco-Flex are Allis-Chalmers trademarks.

A-1579

ALLIS-CHALMERS

NEW FROM RACO



Oval Service Entrance Cable Connectors. These new pressure-cast oval service cable connectors feature a newly designed shorter throat. The sturdy, non-watertight connector attaches easily to service entrance switch. Clean, smooth threads and burr-free edges eliminate danger of wire snagging and damaged cable. Available in five sizes from ¾" to 2".

Offset Mast Base Reducer. New Raco offset mast base reducer threads directly into meter box. No nipple needed. One piece for easier, faster handling. Offset design makes it perfect for use next to a wall. Available in four popular sizes—2"-1¼", 2"-1½", 2½"-1¼" and 2½"-1½".

Fittings For Every Need

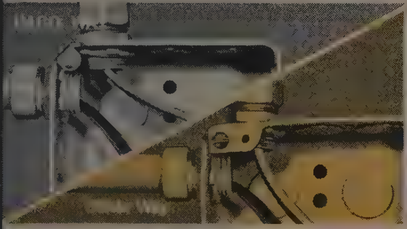
- Rigid Conduit
- E.M.T. (thinwall conduit)
- Armored bushed cable, flexible metallic tubing and non-metallic cable
- Service entrances

RACO

One-Screw Ears are Better Than Two

Raco 4" square box with one-screw ear.

One-screw ear gives you flexibility



MORE WORKING ROOM

Raco one-screw ear design boxes give you more working room. Result: More wiring room, all KO's usable, two extra runs per box.

NO EARS TO CLIP

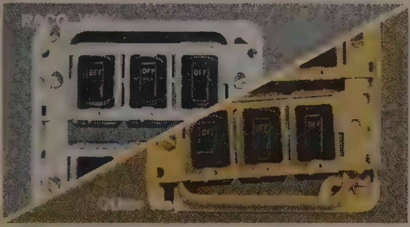
No lost motion clipping ears. No screws to move or lose using Raco one-screw ear boxes.

NO WIRE SKINNING PROBLEMS

With Raco's one-screw ear design, wire comes through clean—no skinning. You have more room. Smaller ears don't get in the way.

MOUNTS IN ANY POSITION

Whatever position you mount these versatile boxes in, you're always right. You can't install them wrong.



SPECIAL APPLICATIONS

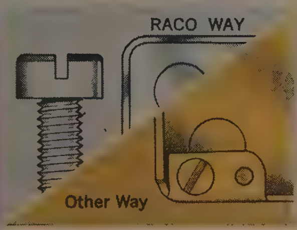
Due to the design of Raco's one-screw ear box, you have plenty of room for despard devices or as a transformer housing.

HEAVY DEVICES MAY BE USED

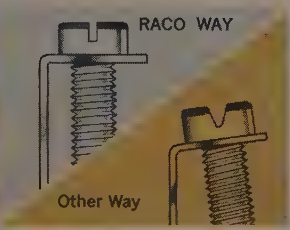
The one-screw ear gives you more working room when installing switches and heavy duty receptacles. Get speedier installation.

Raco quality saves you money

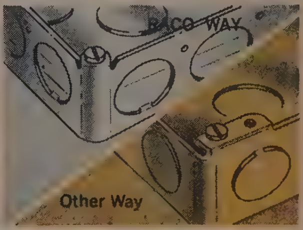
SQUARE SCREW SLOTS. A screw driver won't slip out of the milled slots in Raco screws. No wasted motion—no loss of time.



SCREWS PLATED SEPARATELY. Every screw—and every clamp—is plated before it is put in a Raco box. No rusting. Little details pay off in big savings.

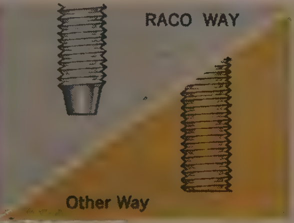


SQUARE EARS. Ears on Raco boxes are always 90° angle. You waste no time "pulling down" ears. Raco boxes are always square, never distorted.

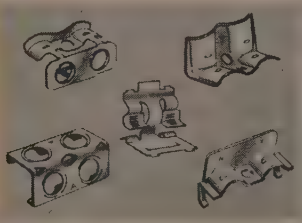


KO TIES AT BOTTOM. You can reach in a Raco box and remove any knockout with ease. Just twist, pull and you're ready to roll. Try it.

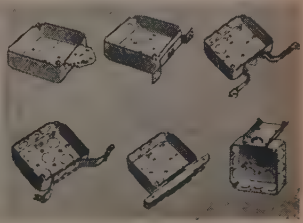
BOTTOM KO's. Clean-cut, Raco bottom KO's are on the inside of the box. It's easier to reach in, than around.



DIE-POINTED SCREWS. Raco's specially designed die-pointed screws go in speedier and easier. The time saved adds up to big dividends for you.



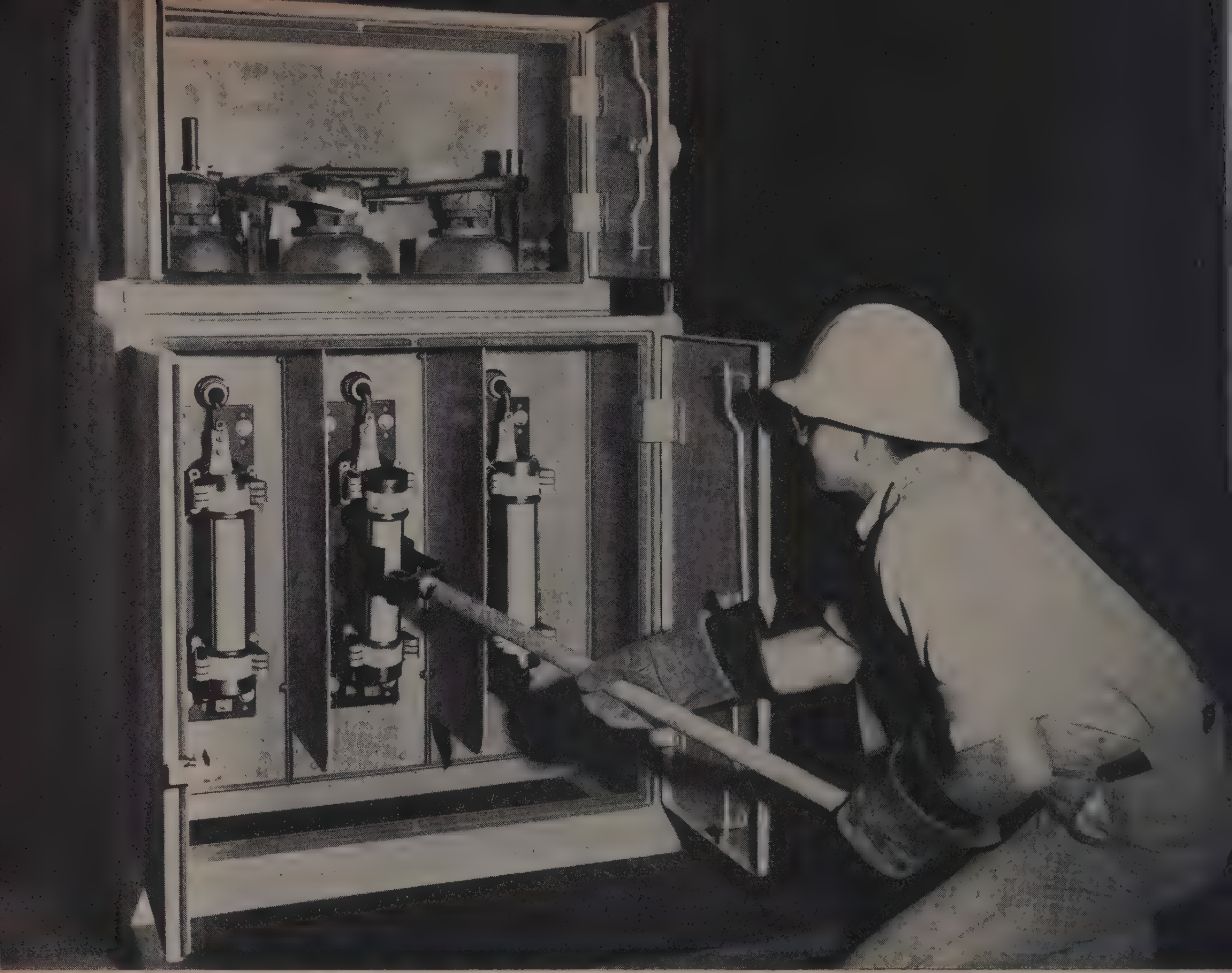
CLAMPS FOR EVERY JOB. There's a Raco one-screw ear box with a metallic or non-metallic cable clamp you need. • Q clamp • X clamp • L clamp • C clamp • N clamp

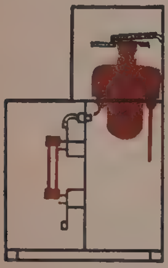


WIDE RANGE OF MOUNTING BRACKETS. Raco 4" square boxes are available with these brackets. • B bracket • O bracket • F bracket • A bracket • W bracket • J bracket

RACO®

ALL-STEEL EQUIPMENT INC., Aurora, Illinois





GENERAL ELECTRIC'S F/O INTERRUPTER SWITCH . . .

A NEW way to switch load and interrupt faults—safely, quietly, economically

Now, for the first time, you can use a low-cost fault interrupting and switching assembly for loads that do not require or cannot economically justify more expensive equipment.

General Electric's new F/O (Fused Oil) Interrupter Switch combines versatile, vented oil cutouts with current-limiting power fuses in one compact, low-cost unit, for maximum economy in handling loads with high short-circuit currents available.

The advanced new switch design closely co-ordinates fused oil cutouts with power fuses. Only inexpensive oil cutout fuse links need be replaced for low-current faults. High fault currents are interrupted safely and quietly by reliable EJO-1 fuses—which operate without expulsion gases.

Weatherproof housing makes this compact unit suitable for floor-, wall-, or ceiling-mounted installation—indoors and out. Separate, safety-interlocked cutout and fuse compartments protect your operating personnel. Explosive and contaminated atmospheres pose no problems.

For the complete F/O Interrupter Switch story, contact your General Electric Sales Representative. Or, write the General Electric Company, Section 488-09, Schenectady 5, New York.

RATINGS:	5.2 kv, 100 amp to 15 kv, 200 amp
SWITCHING ABILITY:	to 900 amp
INTERRUPTING ABILITY:	to 60,000 amp
NET WEIGHT*:	800 lbs.
DIMENSIONS*:	62"H x 38"W x 38"D

**5.2-kv, 100-amp unit*

Progress Is Our Most Important Product

GENERAL ELECTRIC

Typical Applications: Overcurrent protection and load switching for hospitals, schools, factories, office buildings, shopping centers, residential underground sectionalizing, and mines.

61ST YEAR • FEBRUARY 1962

ELECTRICAL
CONSTRUCTION
AND MAINTENANCE

New York's Electrical Strike

After a short but costly strike Local 3 (New York City) of the International Brotherhood of Electrical Workers, won a sensational but nominal 5-hour day, 25-hour work week, to become effective July 1, 1962. The 9,000-man construction division comprises the largest local union of the Brotherhood and one of the most powerful in all the building trades. It has contracts with 600 licensed electrical contractors in the city, and its members provide practically the entire electrical labor force to the city's huge new building construction industry.

The strike followed from a deadlock in negotiations and the ultimate expiration of the contract. It climaxed under TV cameras and nationwide news coverage. Why, in industrial relations which never in 40 years had gone beyond the bargaining table, did Local 3 call upon its ultimate weapon at this time? Some say astute Business Manager Harry Van Arsdale, Jr. wanted a quick, forceful and dramatic settlement, to give spectacular leadership to a nationwide labor movement for a shorter work week. If this was the objective, it was brilliantly successful.

The contractors fared poorly in public image. Under the impact of the strike they broke ranks and the majority found themselves in the position of accepting terms already widely publicized. The settlement was heralded in the press as an outstanding victory for Local 3.

Actually, the resulting agreement was within range of what was easily predictable from the early stages of negotiations. The shorter week issue was met half way between the union's nominal 4-hour day demand and the contractors' nominal 6-hour day holding position. The hourly wage increase of 56 cents could be predicted almost to the penny from the precedents of recent years. Furthermore, the union made several substantial concessions on apprenticeship, manpower supply and "secondary" rate work which are still to be negotiated.

As a practical matter, the electrician's work day in New York is established by the prevailing construction day which is seven hours. There is no change in prospect. Labor requirements suggest that the electricians may have to continue working seven hours under the new contract with a considerable increase in premium pay. However, the union insists that a shorter week will actually be achieved.

In our opinion, the sensational negotiations, strike and settlement were, as they say in Brooklyn, a wrong mistake. The resulting lavish publicity was acutely unfavorable to the union and to the industry. Whatever real benefits to its members the union actually sought and won, unquestionably could have been achieved in moderate steps through conventional bargaining procedures.

Wm. T. Stuart

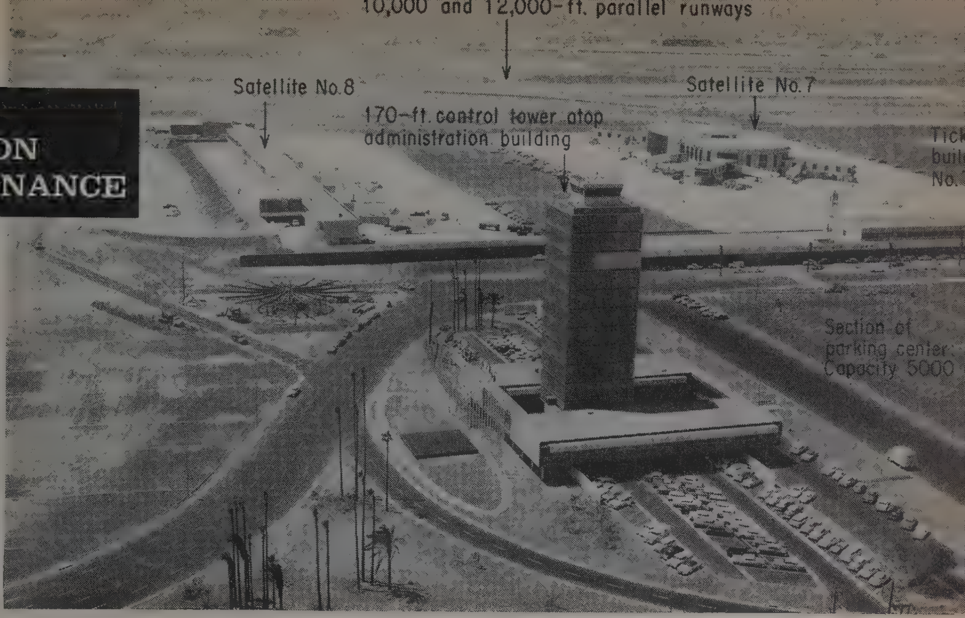
BOLTED PRESSURE!...EVERY BULLDOG SAFETY SWITCH GIVES YOU BOLT-TIGHT PRESSURE AT THE SWITCHING POINT, GIVES YOU LONGER SWITCH LIFE. BUY QUALITY...BUY BULLDOG. CONTACT YOUR I-T-E DISTRIBUTOR OR LOCAL I-T-E SALES OFFICE. DO IT TODAY!!

Write for your copy of "The Story Behind the Ad".

I-T-E CIRCUIT BREAKER COMPANY
BULLDOG ELECTRIC PRODUCTS DIVISION
BOX 177 • DETROIT 32, MICHIGAN

In Canada: 80 Clayson Rd., Toronto 15, Ontario

ELECTRICAL
CONSTRUCTION
AND MAINTENANCE


10,000 and 12,000-ft. parallel runways
Satellite No.8
Satellite No.7
170-ft. control tower atop administration building
Tick
buil
No.
Section of parking center: Capacity 5000

AERIAL VIEW shows four of 24 recently completed structures at new passenger terminal addition to 3000-acre Los Angeles airport. Initial electrical load of 30,000-kva is obtained through nine substations, each served by dual 34.5-kv primary oil-filled feeders. Complete passenger facilities are designed to handle 23-million air travellers annually.

Jetport Power

Outstanding Electrical Construction

Primary service at 34.5 kv; an initial electrical load of 30,000 kva; nine substations; 530 miles of wire; 285 miles of raceways and 23,000 lighting fixtures in 24 buildings are some impressive statistics related to huge new Los Angeles air terminal.

By Hugh P. Scott

LOS ANGELES International Airport last year registered over 300,000 plane landings and takeoffs; served 6.6-million air passengers; handled 147-million pounds of air freight plus an additional 48-million pounds of mail. These totals were four times greater than initial airport design values. Yet, according to trends and conservative estimates, these totals will again multiply 4-fold within a decade; indicating that 23 million passengers will pass through the port in 1970, with freight and mail volumes increasing proportionately.

Needless to say, existing facilities are strained well beyond limits of either efficiency or reason. Pressures will be lessened this year, however, because a completely new Global Air Harbor has just been dedicated and a third new runway is now alleviating plane congestion on and above the terminal.

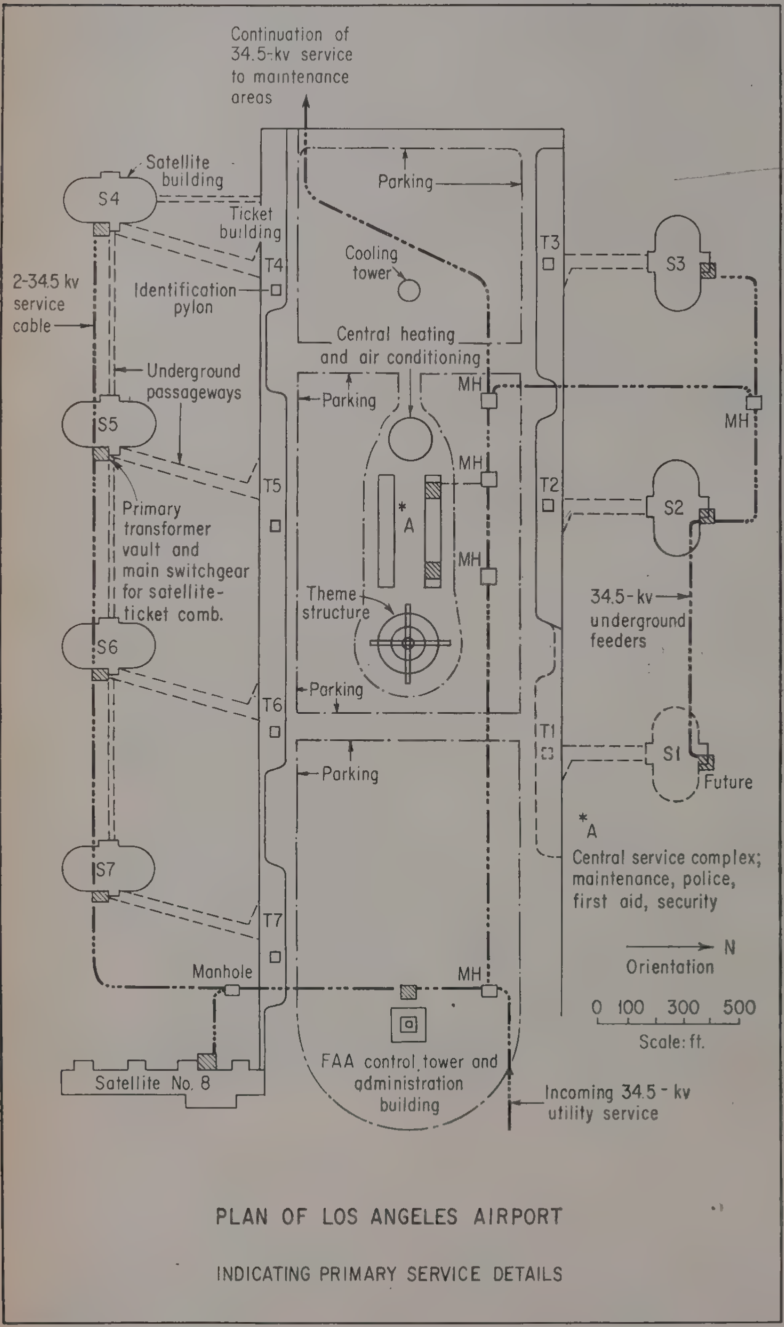
These new facilities occupy a 265-acre site northwesterly adjacent to the present 2800-acre airport. Construction contracts related to new work already have exceeded $46-million. The electrical contract alone represents more than 10% of this figure, involving such quantitative statistics as 530 miles of wire and cable, 285 miles of conduit and ductwork, and more than 23,000 lighting fixtures (representing 150 different designs) containing over 35,000 lamps.

As indicated by an accompanying plot plan, facilities include a new administration building with an imposing 170-ft control tower, seven new ticket and baggage-handling structures, eight terminal satellites, a unique theme building surmounted by a 200-ft "sky high" glass-enclosed restaurant.

Each facility is commendable in its own right from viewpoints of lighting, power distribution and control, functional efficiency, modern equipment and provisions for passenger service.

But although passenger totals at this new terminal will be high, crowd densities and confusion will be minimized because air travellers arriving at the central parking area will disperse to peripheral ticket buildings related to pylon-identified airlines. Then, from dispersed check-in stations, they will travel through tunnels to escalators, up to elevated lobbies in satellites, from whence they will board planes directly through telescopic ramps.

Primary Power Plan


Continuation of 34.5-kv service to maintenance areas
Satellite building
S4
Ticket building
Parking
Cooling tower
T3
S3
T4
2-34.5 kv service cable
Identification pylon
Central heating and air conditioning
Underground passageways
Parking
MH
MH
S5
MH
T5
T2
S2
Primary transformer vault and main switchgear for satellite-ticket comb.
*A
MH
Theme structure
34.5-kv underground feeders
S6
Parking
T6
T1
S1
Parking
Future
*A
Central service complex; maintenance, police, first aid, security
S7
T7
N
Orientation
Manhole
MH
0 100 300 500
Scale: ft.
Satellite No. 8
FAA control tower and administration building
Incoming 34.5-kv utility service
PLAN OF LOS ANGELES AIRPORT
INDICATING PRIMARY SERVICE DETAILS

AIRPORT PLAN functionally locates central service facilities, control tower and theme building at hub; airline ticketing and satellite structures surrounding sunken parking area. Typical substation includes twin 1500-kva 34.5-kv-480/277-volt transformers; load interrupter switches permitting either or both units to be served from either of two primary feeders.

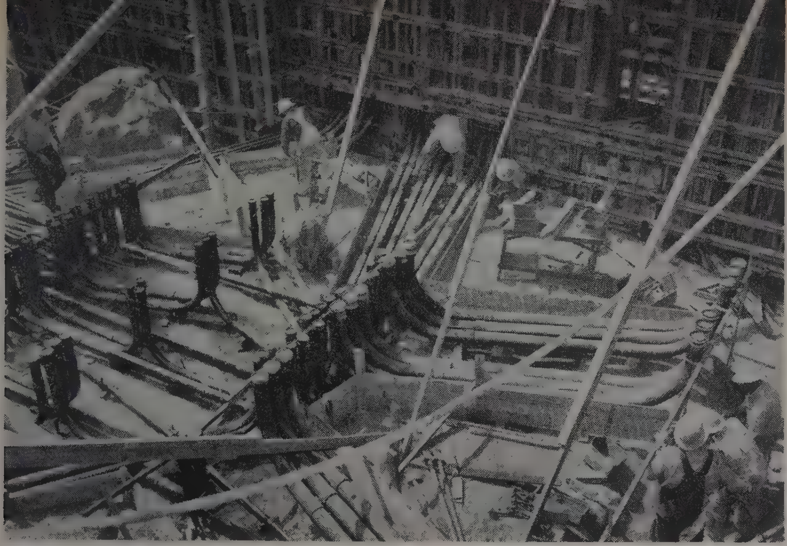
WITH over 1½-million sq ft of covered floor area in this project, it was evident to designers that power requirements would be sizable. And, in anticipation of subsequent expansion and changing electrical demands, it was recognized that the system should also contain spare capacity and flexibility. Projecting load growth for 24 major structures into 1970, however, involved a certain amount of guestimating, so the ultimate provision for 56,750 kva represents the cooperative, considered opinion of electrical consultants, airline and airport personnel alike.

More exact was the establishment of present requirements in the order of 30,000 kva, and this load is being supplied through nine substations served by dual 34.5-kv primary feeders.

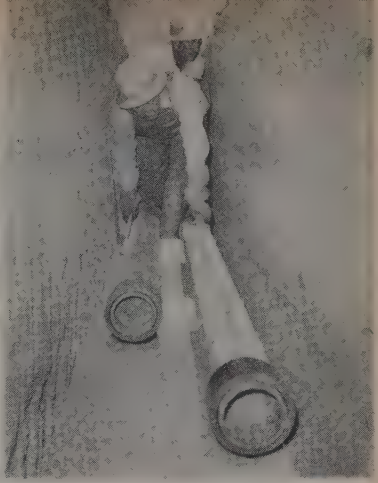
As noted in an accompanying tabulation of substation loads, present values vary from a low of 950-kva for the administration and control building to a high of 5,800-kva for the central power plant, while satellite-ticket complexes vary in present requirements from a high of 5,400-kva in Group 4 to a low of 1,470-kva in Group 8. It should be added, however, that Group 8 should be related to Group 7 as well, inasmuch as both units serve the interests of a single airline (United) which presently handles 38% of all passenger traffic using this airport. Collectively these two substations have a present electrical load of 5,170 kva, with provisions for ultimate loading of 9,400 kva.

As indicated on the plot plan, primary service at 34.5 kv is distributed to these nine dual-transformer substations via dual feeders consisting of lead-covered, paper-insulated, oil-filled 3-conductor cables carried through fibre ducts which, in turn, are routed by deep trench; supported by concrete saddles; and solidly encased by concrete, poured soupy.

At present both 34.5-kv feeders are related to the same utility net-



MASS OF HEAVY CONDUIT is installed in typical substation prior to floor slab pour. To speed installation, conduit was prefabricated into U-shaped assemblies, then supported so that up-sweeping ends were grouped in areas subsequently occupied by switchgear enclosures.



DUAL PRIMARY FEEDERS installed underground in fibre ducts carry 34.5-kv power to nine substations. Feeders consist of lead-covered, paper-insulated, oil-filled 3-conductor cables, while ducts are supported by concrete saddles and encased in concrete sheaths.

ESTIMATED ELECTRICAL LOADS

Structure	Present Loads	Ultimate Provisions
Complex No. 2	2,900 kva	6,700 kva
3	4,100	6,700
4	5,400	6,700
5	3,100	6,700
6	2,600	6,700
7	3,700	6,700
8	1,470	2,700
Control Tower	950	1,350
Central Power Plant	5,800	12,500
Totals	**30,020 kva**	**56,750 kva**

EACH COMPLEX is a combination of satellite and ticketing building with related appurtenances. Of the loads indicated above, ground power for jet aircraft amounts to 10,000 kva. Complexes 7 and 8 are related since both are operated by one air line (United) handling approximately 38% of all passenger traffic at this airport.

BUSBAR STRUCTURE of main switchgear was designed so that connection lugs for feeder conductors were centered directly above related stubbed-up conduit ends, thereby eliminating cable cross-overs and facilitating cable pulling and termination. Note identification bands on conductors, also grounding bushings around conduits at floor level.

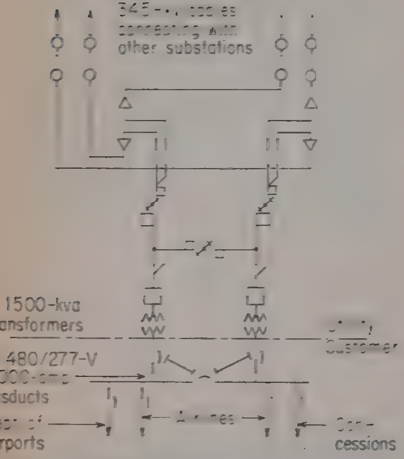
work, although plans contemplate future primary power from two completely separate sources.

Refocussing attention upon the sunken central area, it may be noted that, in addition to the arch-supported elevator-reached theme structure and restaurant, this complex contains a central 4160-volt electric-drive refrigeration plant for air conditioning all terminal facilities; a central commissary for basic food preparation for all airport restaurants (food then being distributed in insulated self-heated or self-cooled trucks and trailers); also a central heating plant with 200-million-Btu-per-hour capacity to provide all facilities with heat, hot water and steam.

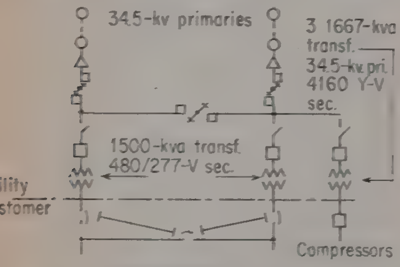
The central complex likewise includes supervisory and maintenance centers equipped with giant operating consoles for monitoring the status of all major circuit breakers, fire detectors and sprinkler systems, excessive transformer temperatures, loss of pressure in oil-filled primary cables, operating conditions of refrigeration and boiler safety devices. These consoles also permit monitoring operations of all motors (5 hp or larger) located in the central area, plus supervision of certain ramp gates, valves, breakers and safety devices referred to above. Complete color coding and telltale lamps on mimic system boards positively identify location, function and existing conditions of all related equipment, some of which are located some distance from the main terminal, such as remote fuel storage and maintenance depots.

Since this new airport addition will handle passenger traffic only, all formerly existing terminal facilities now can be devoted solely to the handling of air freight, mail and various air-related commercial operations.

Substation Variations



TYPICAL SERVICE TO SATELLITE SUBS



SUBSTATION IN
CENTRAL SERVICE COMPLEX
(has separate transf. bank to
serve 4160-V compressors)

TRANSFORMERS feed through separate main circuit breakers to split-bus structure which is automatically unified if either main breaker opens. Should a primary fault occur, watch engineer in remote supervisory center would be advised immediately by indicating warning pilot lights, alarms and printed records.

TWO basic substation arrangements may be noted on an accompanying line diagram; one pertaining to stations located adjacent to satellites, the other to the central power plant.

Referring to the first group, each station is served by both primary feeders. Depending upon settings of load interrupter switches installed at bus-tie positions, either or both transformers can be served from either 34.5-kv main line. Since transformers can be switched under load from one line to the other without interrupting service, either line can quickly and safely be inactivated, if so desired, in case of emergency or for inspection or maintenance.

Twin transformers at satellite stations are 3-phase units that step primary power to 480/277 volts for further distribution. In most cases transformers are 1500-kva units, with loads so balanced that, under normal conditions, maximum demands are less than 70% of rated normal-operation transformer capacities. Each transformer feeds through a separate main circuit breaker to a split-bus structure; each section of these buses being rated at 2000 amps, and the two sections being related through an automatic tie breaker that closes should either main breaker open.

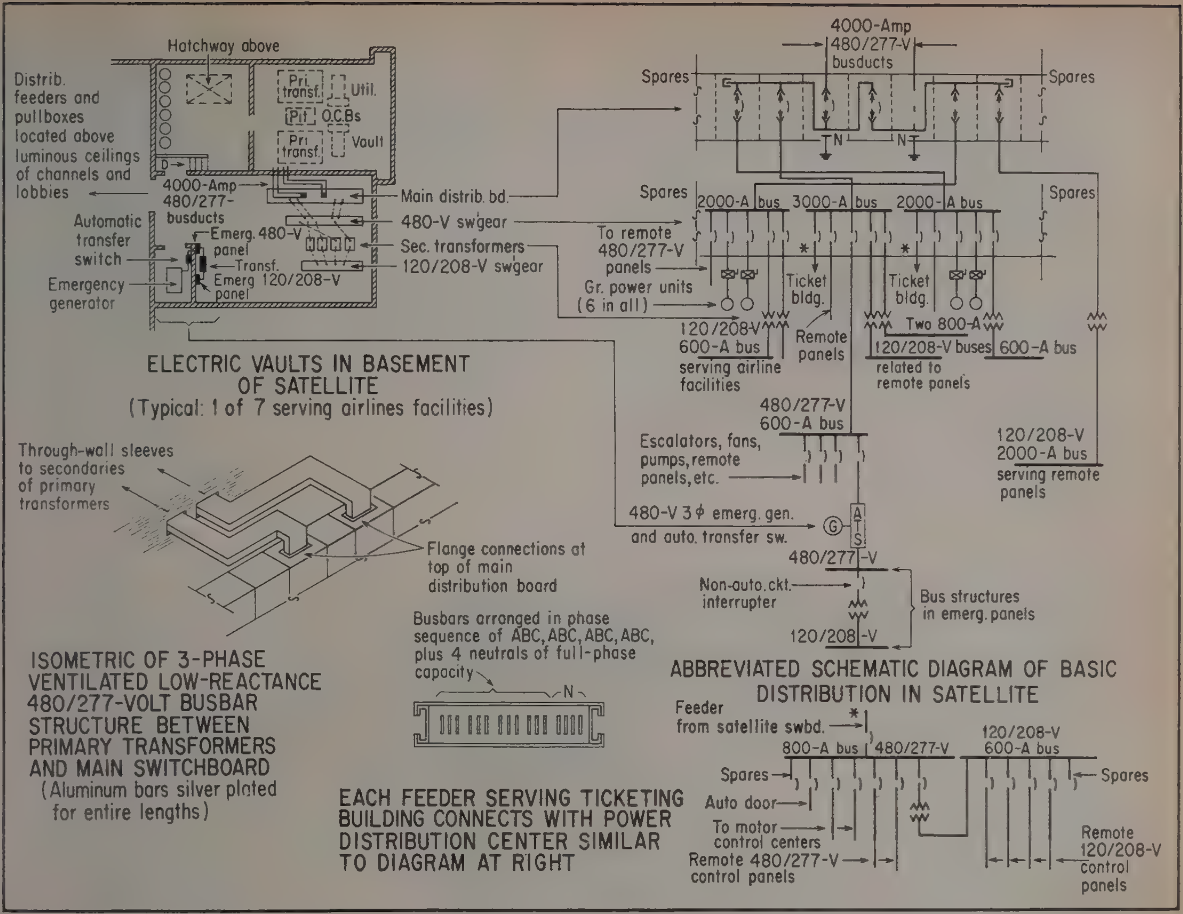
With this arrangement should a primary cable fail or its internal oil pressure drop, the cable's load would be transferred to the companion feeder; transformers would be reconnected accordingly; the watch engineer in the central-complex supervisory center would be so advised by remote alarms, printed records and indicating warning pilot lights; and the line switch related to the faulted 34.5-kv feeder would be opened automatically pending further investigation. Similarly, should any transformer fail, automatic switching of related primary and secondary line and tie breakers would promptly take the faulted unit out of service, while alarms and lights would likewise reveal this fact at the central station.

The substation located at the central power plant differs from this arrangement in several details. For example, there are three, rather than two, 1500-kva 3-phase transformers stepping current to 480/277 volts for operation of pumps, fans, general lighting and miscellaneous power. In addition, a 5000-kva bank of single-phase transformers provides 4160-volt power for operation of electrically driven centrifugal refrigeration compressors collectively rated for ultimate load of 5000 tons. Prime movers for these compressors are 5-kv synchronous motors; a motor-compressor combination resulting in reduced initial installation and operating charges.

Other substation arrangements also exist; for example (1) in the administration building where three wye-connected transformers, each rated at 250-kva, are located in an underground vault located some distance away from the building due to local structural and access problems; also (2) at remote stations such as those serving fuel storage pumping stations, where single transformers are installed with various safety provisions. The two arrangements discussed in detail above, however, are the basic ones.

In discussing substations it is pertinent to mention that use of 3-phase transformers, rather than grouped single-phase units, resulted in more compact installations; therefore reducing size and cost of underground vaults. In the case of satellite stations, such vaults measure 30 by 35 ft in floor plan; 17 ft in height; with top access hatchways for equipment, underground access passageways for personnel, and with thermostatically controlled blowers to provide forced ventilation.

SPLIT PULLBOX with integral partition isolates conductors related to separate feeders, thereby insuring segregation of alternate distribution channels in event of fault in one line. Note method of suspending conduit with tiered trapeze hangers, rod hangers and expansion anchors in overhead slab.


Hatchway above
Distrib. feeders and pullboxes located above luminous ceilings of channels and lobbies
Pri. transf.
Util.
Pri. O.C.Bs
Pri. transf.
Vault
4000-Amp 480/277-busducts
Main distrib. bd.
480-V swgear
Sec. transformers
120/208-V swgear
Automatic transfer switch
Emerg. 480-V panel
Transf.
Emerg 120/208-V panel
Emergency generator
ELECTRIC VAULTS IN BASEMENT OF SATELLITE
(Typical: 1 of 7 serving airlines facilities)
4000-Amp 480/277-V busducts
Spares
N
N
Spares
2000-A bus
3000-A bus
2000-A bus
Spares
To remote 480/277-V panels
Gr. power units (6 in all)
Ticket bldg.
Ticket bldg.
120/208-V 600-A bus serving airline facilities
Remote panels
Two 800-A 120/208-V buses related to remote panels
600-A bus
480/277-V 600-A bus
Escalators, fans, pumps, remote panels, etc.
120/208-V 2000-A bus serving remote panels
480-V 3φ emerg. gen. and auto. transfer sw.
G
ATS
480/277-V
Non-auto. ckt. interrupter
Bus structures in emerg. panels
120/208-V
Through-wall sleeves to secondaries of primary transformers
Flange connections at top of main distribution board
Busbars arranged in phase sequence of ABC, ABC, ABC, ABC, plus 4 neutrals of full-phase capacity
N
ISOMETRIC OF 3-PHASE VENTILATED LOW-REACTANCE 480/277-VOLT BUSBAR STRUCTURE BETWEEN PRIMARY TRANSFORMERS AND MAIN SWITCHBOARD
(Aluminum bars silver plated for entire lengths)
ABBREVIATED SCHEMATIC DIAGRAM OF BASIC DISTRIBUTION IN SATELLITE
EACH FEEDER SERVING TICKETING BUILDING CONNECTS WITH POWER DISTRIBUTION CENTER SIMILAR TO DIAGRAM AT RIGHT
Feeder from satellite swbd.
800-A bus
480/277-V
120/208-V 600-A bus
Spares
Spares
Auto door
To motor control centers
Remote 480/277-V control panels
Remote 120/208-V control panels

MAIN DISTRIBUTION BOARD in each satellite obtains 480/277-volt power from adjacent primary vault via twin 4800-amp busways each normally serving half of the split-bus structure. Secondary transformers provide 120/208-volt service as required in ticket building as well as satellite. Each substation likewise is provided with emergency power.

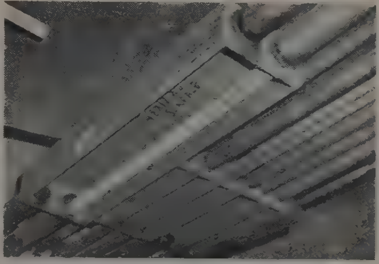
As a variation of this general vault design, substation enclosures located within the central complex are only partially buried so that convection cooling through screened louvers is possible.

Aside from these major 480/277-volt substations, 40 local dry-type 480-208/120-volt transformers (having combined ratings of approximately 8000 kva) are provided in various locations to satisfy increments of incandescent lighting and incidental power.

Power provided by self-contained generator units is related to three different purposes: emergency, temporary and 400-cycle power for plane services.

The first purpose (that of emergency power) is satisfied by small engine-driven generators located in all satellite buildings, with automatic starting of units and transfer of critical exit and night lights in event of an outage in normal distribution mediums.

The second purpose (pertaining to temporary power during the 2-year construction period), was satisfied by 50-kw diesel generators which were sled-mounted for mobility. Use of these units was dictated by the facts that (a) it would have been extremely impractical to install temporary aerial distribution lines in such a large area where earth movement and crane operations were so extensive and so continuous, and that (b) the possibility for using initially laid primary ducts to route temporary low-voltage cables to construction centers was precluded by utility restrictions.



BANK OF FEEDERS in long straight run passes through special pull-box assembly combining expansion fittings and parallel partitions to segregate conductors related to different services.

The third purpose (400-cycle power for lighting and air conditioning jet planes while they are parked on loading aprons), is satisfied by apron-recessed 75-kva installations having demand factors that range between 60 and 100%. As many as ten such generator stations surround each satellite, in some instances (when located directly beneath plane parking positions) being installed in explosion-proof pits containing keyed plug outlets for various plane services.

To support the considerable weight which is exerted through large jet plane landing wheels, construction of pits and hinged access covers is necessarily rugged and heavy. The 120-lb lids may be raised with a 35-lb pull, however, due to spring-loading and planned balance.

Practical Job Methods

ONE of many practical methods practiced by the contractor concerned application of protective coatings on underground ducts and conduits where prevention of rust and rot was essential. Normally a manual time-consuming chore, this job was accomplished quickly and satisfactorily by (1) using forklift trucks to transfer bundles of ducts and conduit to central installation locations, (2) "flipping" the truck forks so that raceways were rolled onto timber cradles in a single layer, then (3) applying various liquid coatings by high-pressure spray guns. After ducts and conduits were installed, cable pulling was facilitated by use of power winches and boom trucks.

Due to the unusually large quantities and extreme lengths of cables being installed, the contractor requested manufacturers to deliver cables on the largest possible reels commensurate with production feasibility. As a result, 500 MCM cable (of which over 100 miles were used) was delivered in over-all lengths of 1000 ft, while cables of smaller gauge were delivered in correspondingly greater quantities.

To speed installation of underground ducts and conduits in primary substations, considerable prefabrication and mass assembly was adopted. For example, to establish underground connections between main and subfeeder switchgear in vaults, rigid steel conduits were bent into massive U shapes, then were buried beneath floorslabs with upsweeping temporarily capped ends terminating within areas to be confined subsequently within switchgear enclosures.

Some of this switchgear was slightly modified in design in order to center busbars and cable connection lugs directly above related stubbed-up conduit ends. This modification eliminated cross-overs of main feed cables.

Another practical expedient observed during construction was the use of "dry" rotary-impact core drills for piercing 12-in. concrete floorslabs. Had this operation been performed with normally "wet" diamond drills, cooling water could have dripped through to finished areas below; drills would have required anchors on the rough and uneven decks; and holes angled close to walls would have been difficult to align. However, by using dry drills rotating at 1200 rpm and delivering 7200 impacts per minute, holes were cut cleanly at rates of 6 in. per minute through reinforced slabs. According to job foremen, this dry drilling method obtained considerable time savings, not only in drilling but in set-up periods as well; a factor of importance when considering that over 300 holes averaging 2 in. in diameter were drilled in satellites 7 and 8 alone.

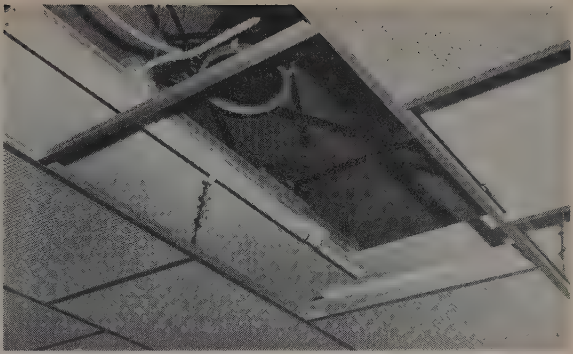
Due to the scope of this project, engineering and wiring plans were unusually numerous. Many also were unusually detailed, including meticulous directions concerning which wires (identified by color) were to be connected to which terminals (identified by position or number) within various intricate control assemblies. This attention to detail admittedly took more time in design stages, yet it paid dividends by insuring accuracy of wiring. Field electricians did not have to guess or assume; hook-up routines were simplified and standardized; and wiring efficiencies were improved as a result.

Practical methods related to lighting were numerous. For example, in several areas fixtures were supported by mounting bolts positioned with powder-activated stud guns. Stud threads were then wrapped with plastic electrical tape so that, after plastering had been spray-applied to the general ceiling area, the tape could be easily stripped off, leaving threads bare, clean and ready to receive fixtures.

Another ingenious method was noted in baggage pick-up areas where an unusually large number of parallel rows of recessed 2-lamp fluorescent fixtures equipped with plastic diffusion panels were installed. These rows of fixtures start close to interior walls, extend across block-long ceiling areas, continue through all-glass curtain walls and extend out to edges of canopies overhanging adjacent driveway-bordering walks. In such instances, where end-to-end mounting of fixtures is duplicated on such large scales, it is not uncommon to notice slight variations in over-all lengths

FORK TRUCKS were used to deliver bundles of conduit and ducts in bulk to installation centers. In cases where protective coatings were prescribed for raceways, truck operators rolled conduits onto cradles in single tiers for mass-coating via high-pressure sprayguns. Arch observed in background is designed to support restaurant 200 ft above ground, while tall pylon will carry identification for one of seven ticketing buildings.

DELIVERY OF LIGHTING FIXTURES was via pallets and rod-braced crates with plastic covering to insure cleanliness. Pallets were then moved by fork truck to central installation areas as required.



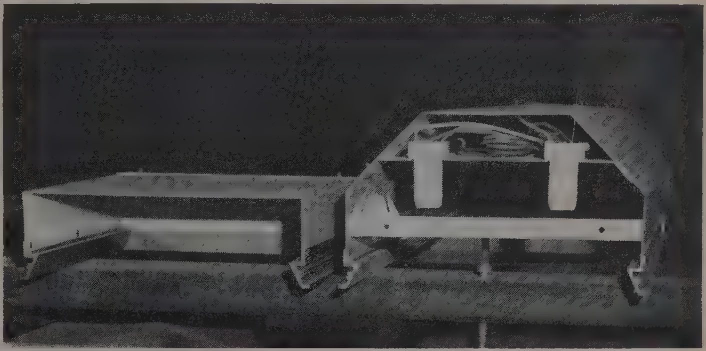
SUSPENSION of framework for support of cellular ceiling panels is facilitated through use of readily adjustable hangers consisting of overlapping rods and friction spring-clips that hold rods together in desired positions. Note positioning of lamps just below acoustical overhead, with ballasts mounted in plenum above. Ring frame in photo supports speaker for public address and background music dissemination.

of troffer runs; such variations resulting from summations of countless small increments in connection gaps between adjacent fixtures. In this instance, however, it is commendable that ends of all rows are in exact alignment, as are the "breaks" as they pass through the all-glass curtain walls.

This exactitude was achieved by the simple expedient of adding variable-length "dummy" reflectors to ends of rows as needed. These dummy or auxiliary reflector sections are open at one end, closed at the other, and exactly duplicate in cross-section the recessed fixtures being installed. Auxiliary sections were delivered in 12-in. lengths. And, since the metal is easily cut with a hacksaw, these dummy reflectors could be added to ends of rows to obtain exact over-all measurements to fit the varying requirements.

Auxiliary reflector sections do not contain any lamps, yet sufficient light spills outwards from open-end fixtures placed adjacently, thereby illuminating the dummy diffusion bottom panels. Close visual inspection will reveal that brightness of the short auxiliary dummy sections diminishes slightly from the brightness of adjacent lamped full-length fixtures, yet this fall-off is so gradual that it is scarcely perceptible.

Incidentally, fixtures were delivered on pallets and plastic-encased frame crates, making it possible for quantities to be moved in bulk by fork truck to installation centers as required, and insuring safety and cleanliness of fixtures until uncovered and uncrated.



DUMMY REFLECTORS (left) were obtained in 12-in. lengths, then cut with hacksaws to shorter lengths as needed so that, when installed at ends of long continuous rows of fixtures similar to unit shown at right, over-all alignment of all rows would be exact. Diffusing panels of dummy sections obtain sufficient spill-light from open ends of adjacent lamped fixtures to preclude noticeable drop-off in over-all panel brightness.

DRY ROTARY IMPACT DRILL was used to pierce 12-in. reinforced concrete slabs. Rotating at 1200-rpm and delivering 7200 impacts per minute, tool drilled holes averaging 2 in. in diameter at average rate of 6 in. per minute. Since water was not involved in the operation, dripping to finished areas below was avoided and only small working area had to be cleared of debris.

LARGE REMOVABLE FACEPLATE in downlight assembly can be snapped on and off easily to simplify relamping and cleaning the integral spheroid reflector. Faceplates are designed with recessed lips which may be filled with plaster to match general ceiling treatment. Center cardboard disc prevents construction dust from entering fixture during installation period.

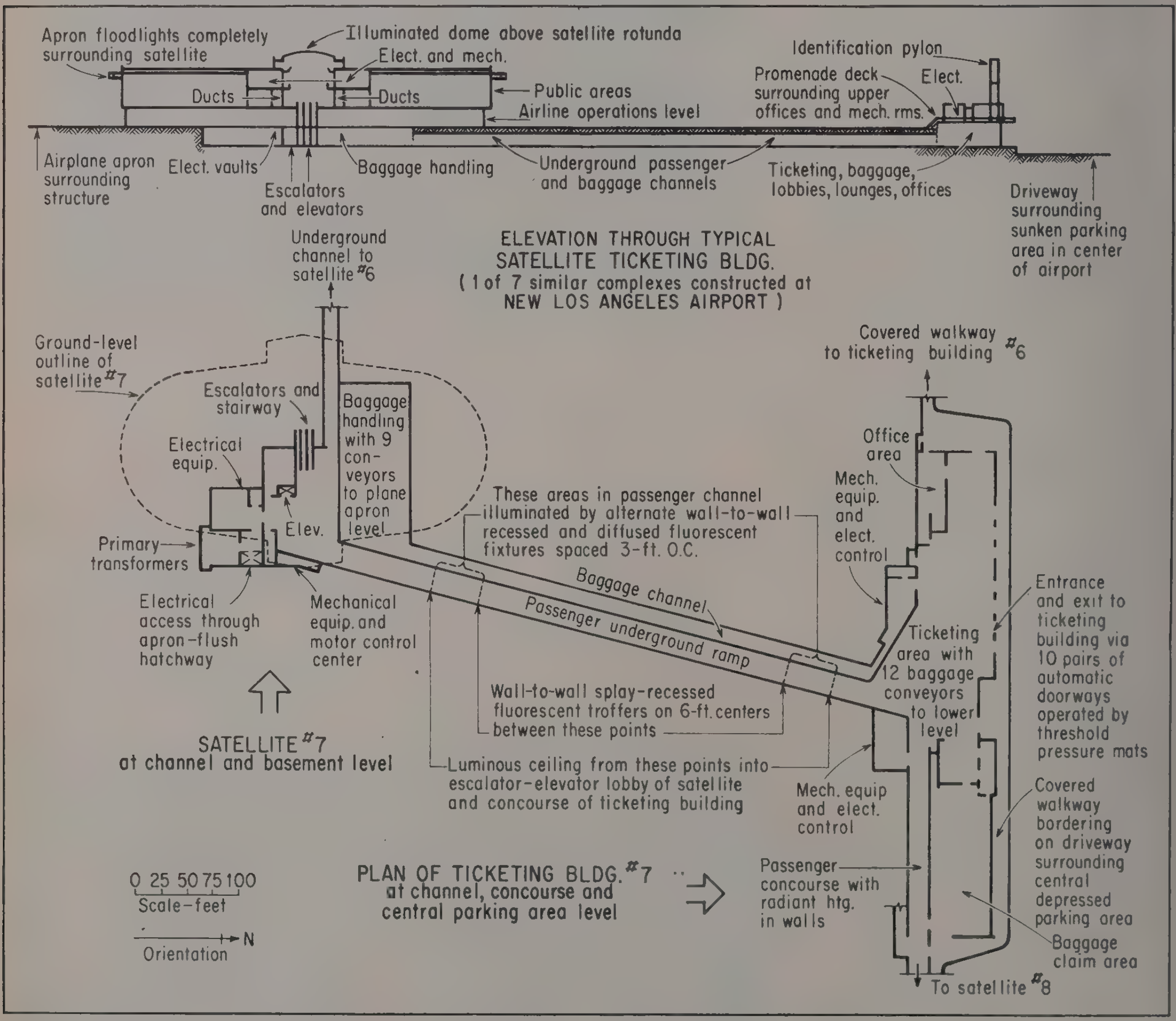
Continuous Floodlighting

ILLUMINATION of loading aprons surrounding satellites is accomplished by 1500-ma high-output fluorescent lamps installed in multiple rows in optically designed fixtures that completely encircle each terminal building above the high window walls.

Since units are architecturally integrated into over-all designs of structures, they constitute distinct decorative elements. Since fixture design conceals lamps from eyes of people looking out from satellite lobbies, no possible glare can reach them, while apron and plane activities are dramatically highlighted by this simulated stage-lighting technique. Since fixtures are mounted high above the field, and light is directed downwards at a considerable angle, glare is minimized in the direction of taxiing pilots and CAA personnel in the high control tower. And, since light levels in plane-parking areas are in the order of 20-25 horizontal footcandles with 10-fc on vertical surfaces, ample illumination is available for critical inspection and maintenance of planes, plus safe handling of baggage and food.

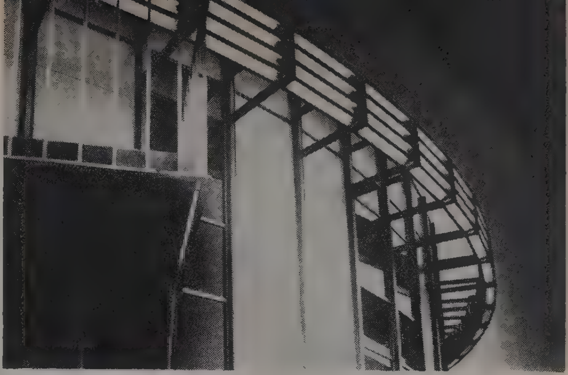
This blanket of illumination extends outwards from satellites some 300 ft, aiding pilots to easily identify destinations and taxi lanes, to steer clear of possible obstructions, and to jockey planes into exact positions above fuel stations and previously mentioned 400-cycle generator pits. This high-intensity lighting system also has the psychological plus-value of bolstering passenger morale.

On the general subject of illumination it also may be noted that large-area installations are remotely controlled through contac-


Apron floodlights completely surrounding satellite
Illuminated dome above satellite rotunda
Elect. and mech.
Ducts
Ducts
Public areas
Airline operations level
Identification pylon
Promenade deck surrounding upper offices and mech. rms.
Elect.
Airplane apron surrounding structure
Elect. vaults
Escalators and elevators
Baggage handling
Underground passenger and baggage channels
Ticketing, baggage, lobbies, lounges, offices
Driveway surrounding sunken parking area in center of airport
ELEVATION THROUGH TYPICAL SATELLITE TICKETING BLDG.
(1 of 7 similar complexes constructed at NEW LOS ANGELES AIRPORT)
Underground channel to satellite #6
Ground-level outline of satellite #7
Escalators and stairway
Electrical equip.
Baggage handling with 9 conveyors to plane apron level
Elev.
Primary transformers
Electrical access through apron-flush hatchway
Mechanical equip. and motor control center
SATELLITE #7 at channel and basement level
These areas in passenger channel illuminated by alternate wall-to-wall recessed and diffused fluorescent fixtures spaced 3-ft. O.C.
Baggage channel
Passenger underground ramp
Wall-to-wall splay-recessed fluorescent troffers on 6-ft. centers between these points
Luminous ceiling from these points into escalator-elevator lobby of satellite and concourse of ticketing building
Covered walkway to ticketing building #6
Office area
Mech. equip. and elect. control
Ticketing area with 12 baggage conveyors to lower level
Entrance and exit to ticketing building via 10 pairs of automatic doorways operated by threshold pressure mats
Mech. equip and elect. control
Covered walkway bordering on driveway surrounding central depressed parking area
Passenger concourse with radiant htg. in walls
Baggage claim area
To satellite #8
0 25 50 75 100
Scale-feet
N
Orientation
PLAN OF TICKETING BLDG. #7 at channel, concourse and central parking area level

TYPICAL SATELLITE measures 330 by 200 ft overall. Substation, main switchgear and automatic electronic baggage handling facilities are below ground; communication center and all airline operations at plane apron level; upper floors containing passenger lobbies, restaurants, concessions and service centers. Passengers reach second-floor concourse from underground entry ramp either by elevator, escalators or stairways, then board planes through telescopic jetways.

SATELLITES, surrounded by concrete aprons to permit maximum plane parking, are reached through underground passageways. Primary vaults and main switchgear rooms are located below but partially outside basic building to permit direct equipment access through exterior hatchway.



CONTINUOUS BANK of special luminaires contains multiple rows of 1500-ma high-output lamps. Blanket of illumination floodlights plane movements and servicing activities, with obtainment of 25-fc on horizontal surfaces and 10-fc on vertical sections of parked aircraft.

tors, and that numerous special fixtures were designed for specific locations or applications. For example, over mirrored walls in some of the restrooms, special 12-lamp fluorescent soffit units measure 3 by 16 ft.

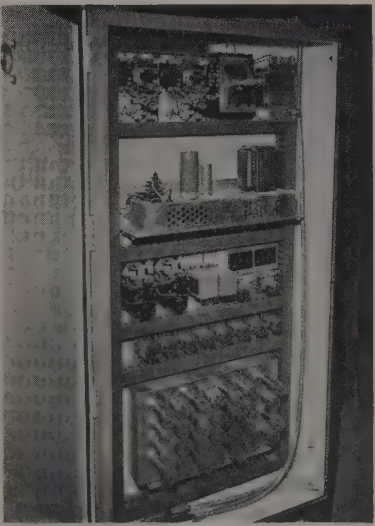
It likewise can be stated that recessed downlights in various public areas differ in diameter. And, since acoustical plaster on some of the ceilings varies in thickness, it was necessary to use a variety of framing channel assemblies to accommodate these differing combinations. However, since each variation was duplicated so extensively throughout the airport as a whole, it was feasible for the contractor to adopt mass-assembly routines in prefabricating these many combinations of mounting rings and framing channels.

Another comment regarding downlights is that large faceplates may be easily snapped on or off to simplify relamping and cleaning of oversized spheroid reflectors. Faceplates are lipped (similar to caps of underfloor duct collars) so the recessed sections may be filled with plaster to match general ceiling treatments. This combines relatively small apertures with large reflectors; provides large ports for easy maintenance access, and adds the esthetic value of matching faceplate textures with surrounding ceiling areas.

In tunnels where baggage is conveyed between ticket buildings and loading aprons, lighting is provided by continuous rows of fluorescent strip lights mounted along both walls, with 2-lamp ballasts installed between every second lamp, and with wiring chassis supported by threaded studs driven into concrete walls by powder-activated guns.

Baggage handling methods likewise are improved; luggage being conveyed between check-in, loading and pick-up stations by a variety of conveyor systems and electric trains characterized by electrical and mechanical details that vary with different airlines. Some of these systems are completely revolutionary in the industry, such as a $\frac{1}{2}$-million "electronic express" installation serving United.

This system is 6000 ft overall; moves at speeds up to 500 fpm; is powered by 152 motors with gross ratings of 185 hp; is electronically coded and permits the airline to check-through baggage of 1500 passengers every hour.



PLUG-IN RELAYS constitute 75% of all control components in baggage system serving satellites 7 and 8. Panel above "reads" coded contacts on moving luggage-carrying trays, then shunts them to designated destinations. Related preselector panel located on Operations level permits destination dialing of coded flight numbers.

Baggage being checked-in is placed on trays equipped with banks of magnetic contacts to permit setting of flight code numbers. Trays then are speeded through underground tunnels to "acceptance" areas beneath satellites where bags are automatically shunted from conveyor to storage racks at the rate of 45 per minute in accordance with related pre-set contactors "reading" the coded destination of luggage at receiving stations.

Passengers may check-in luggage 24 hours before take-offs, if desired, and as many as 860 bags may be carried as "moving storage" until flight acceptance depots are established to receive them. Conversely, arriving passengers will find their luggage waiting for them at claim areas, inasmuch as incoming baggage requires only $1\frac{1}{2}$ minutes to travel from plane aprons to pick-up areas; this interval being less than that required for passengers to walk through the pedestrian tunnel.

To avoid system interruptions, 75% of all relays and related control components are mounted in plug-in racks.

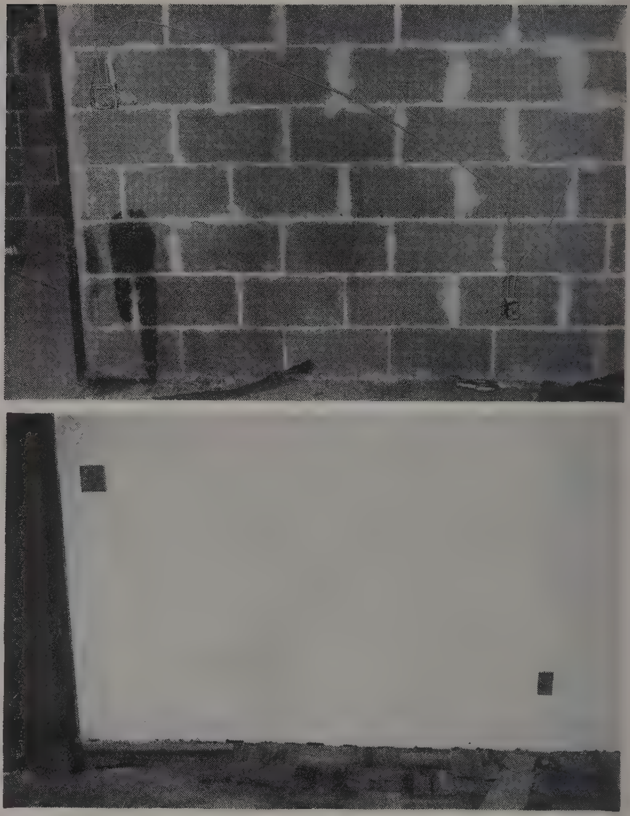
Electrical work included in a $\$4\frac{1}{2}$-million "basic airport electrification" contract, plus considerable additional related work awarded directly by airlines occupying the various passenger facilities, was handled by Fischbach and Moore, Inc., under the direction of field engineer Paul Murphy. The electrical complex likewise reflects credit to consulting electrical and mechanical engineer J. S. Hamel who collaborated with joint-venture engineers and architects Charles Luckman and Assoc.; Welton Beckett and Assoc.; Paul R. Williams and Assoc., plus utility, city and Federal aviation engineers.

A look at code rules on . . .

Cables Under Plaster

Today's applications of armored and non-metallic sheathed cables embedded in plaster finishes on masonry surfaces raise some questions about required mechanical protection.

By J. F. McPartland



TYPICAL APPLICATION of armored cable embedded in plaster wall finish is shown here on a wall in a new, large apartment house which uses this wiring method throughout. At top, cable is shown stapled to wall. Below is same wall after plaster cover.

APPLICATION of cable wiring methods in plaster-wall finishes must observe National Electrical Code rules on mechanical protection. As used in the lightweight construction walls of modern apartment houses, office buildings and other commercial occupancies, such cable installations present a problem in assuring safety. A look at the various cable methods and pertinent code rules pinpoints the safety considerations.

Fig. 1 shows a common method of wiring on walls of apartment houses and other commercial buildings. In this sketch, armored cable is stapled to the surface of a concrete-block wall. The wall is then finished with a thick layer of plaster. The cables, as a result, are buried in the plaster, and the switch and receptacle boxes are partially recessed in the blocks to bring the front edge of the boxes even with the finished wall surface. The question then arises: Is this cable safe from puncturing by nails which might be driven into the wall by occupants (for hanging pictures or for supporting other objects on the wall)? What does the code say about it?

The code does not prohibit the method of cable installation shown in Fig. 1. In Article 334, armored cable is specifically approved for use "embedded in plaster finish on brick or other masonry." There is nothing in this article which regulates the method of installation when armored cable is embedded in plaster. And there is nothing in Article 300, General Wiring Methods, which prohibits use in plaster or requires any supplementary protection for armored cable when used in plaster. The code does not require any specific depth of plaster, covering embedded cable, and makes no attempt to protect such cable against anything which might penetrate the plaster. Presumably, the code feels there is no safety hazard in the possibility that occupants of a building, not knowing if or where cable is concealed under the plaster wall, might drive nails or screws into the wall. But this conclusion is really not justified when other requirements are considered.

Section 334-7 makes certain requirements on supplementary mechanical protection for armored cable, Fig. 2, by referring to Section 300-8. This section is widely and rigidly enforced by electrical inspection authorities. It reads as follows:

"(a) Where exposed or concealed wiring conductors in insulating tubes or *cables* are installed through bored holes in studs, joists or similar wood members, holes shall be bored at the approximate centers of wood members or at least two inches from the nearest edge.

"(b) Where there is no objection because of weakening the building structure, *armored* or non-metallic sheathed cable and type MI cable may be laid in notches in the studding or joists when the cable at those points is protected against the driving of nails into it by having the notch covered with a steel plate at least 1/16 in. in thickness before building finish is applied."

From (a) of the foregoing it is clear that the code wants to keep armored cable at least 2 in. from any edge into which nails might be driven. And (b) requires the steel plate protection when armored cable is close to the edge where nails might hit it. Clearly, this section, in effect, rules that the armor on armored cable is not sufficiently strong to resist damage from driven nails. This concern for additional protection at certain points is difficult to reconcile with apparent lack of concern for long, continuous lengths of armored cable embedded under, say, a ½-in layer of plaster. The opportunities for nail penetration of cable armor are infinitely greater under the latter condition. Yet, such application is permitted and no additional protection is required.

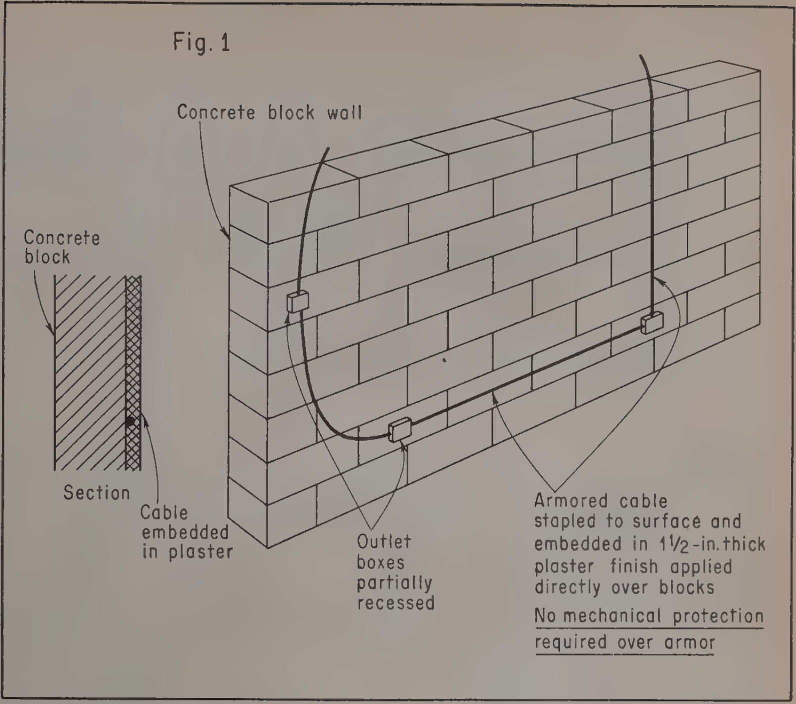


Fig. 1
Concrete block wall
Concrete block
Section
Cable embedded in plaster
Outlet boxes partially recessed
Armored cable stapled to surface and embedded in 1½-in. thick plaster finish applied directly over blocks
No mechanical protection required over armor

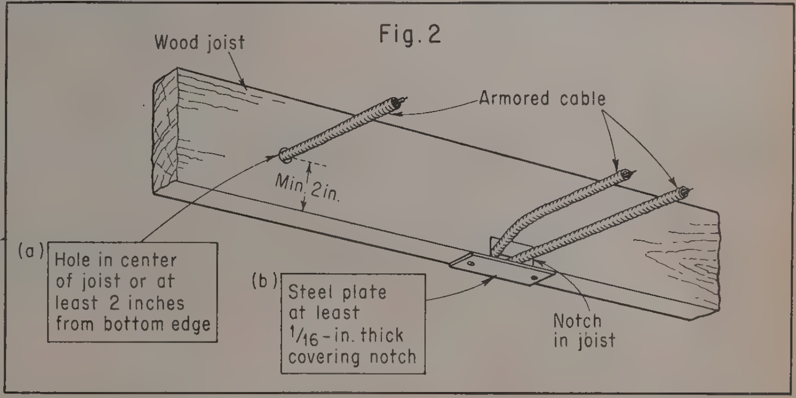


Fig. 2
Wood joist
Armored cable
Min. 2 in.
(a) Hole in center of joist or at least 2 inches from bottom edge
(b) Steel plate at least 1/16-in. thick covering notch
Notch in joist

Armored vs NMC Cable

Although the apparent direct conflict on the ability of armored cable to resist nail damage seems to preclude any conclusion, another code rule seems to support the contention that cable armor is sufficiently protective. This can be deduced from consideration of the code rules on the installation of non-metallic sheathed cable embedded in plaster, Fig. 3. Section 336-3 says the following about moisture- and corrosion-resistant non-metallic (Type NMC) cable:

"This type of non-metallic sheathed cable may be installed for both exposed and concealed work in dry, moist, damp or corrosive locations, and in outside and inside walls of masonry block or tile. Where *embedded in plaster* or run in a shallow chase in masonry walls and covered with plaster within 2 in. of the finished surface, it shall be protected against damage from nails by a cover of corrosion-resistant coated steel at least 1/16-in. thick and ¾-in. wide in the chase or under the final surface finish."

In this rule, it is clear that the code recognizes the possibility of nail penetration of the wall and requires protection for the NMC (or Type UF, which could also be used in the same manner). The fact that the installation requirements differ for plaster-embedded armored cable and NMC cable can only be construed to indicate that the code considers the difference in cable construction and concludes that the armor is sufficient protection for the conductors of armored cable.

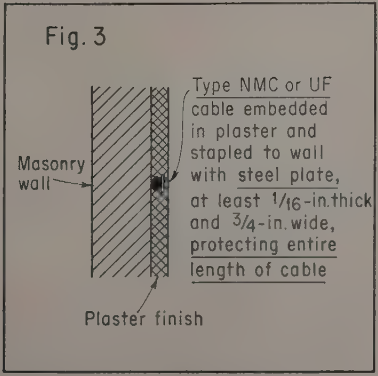


Fig. 3
Masonry wall
Type NMC or UF cable embedded in plaster and stapled to wall with steel plate, at least 1/16-in. thick and 3/4-in. wide, protecting entire length of cable
Plaster finish

But if it's true that armored cable needs no protection when embedded in plaster, why are steel plates needed to protect the cable when installed in notched joists or studs? There is no direct answer. The task of evaluating these code rules, reconciling them with each other, and making safe installations rests with electrical inspectors, installers and designers.

• ESTIMATING FORUM—XVIII

Volume and Operating Costs—Part II

By Ray Ashley, *Research and Consulting Engineer, Oak Park, Ill.*

STATEMENT:

In a previous article (see page 66, *El C & M*, January, 1962) we learned that a one-man business with a $24,000 operating cost could earn 10% on an annual volume of $132,000. This was possible if all direct job costs were included in the estimate as such, and substantial overhead markups were used.

Here, we shall study the prospects of a beginner who uses the much talked about "10 and 10" markups. The first 10% is supposed to cover all operating costs; the second 10% is profit.

For purposes of analysis, let's assume the following conditions:

Operating costs (see Fig. 2) are $19,800.

Rents and incidental expenses are normal.

Average hourly rate for mechanics is $4.00.

Proprietor's salary allowance is 125% of mechanics' rate ($200/week).

Maximum contract is $40,000; minimum contract is $100.

Average contract is $3,000.

Competition for business is normal.

QUESTIONS:

1. If a one-man business could handle the work, what would be the annual volume required to earn 10% profit with the "10 and 10" added to base costs?

2. How many men (average) would be required?

3. What would be the principal limiting factor which would make it impossible for a one-man business to expedite such a large annual volume?

ANSWERS:

1. The required annual volume would be $240,000.

2. Ten men would be required.

3. Time for estimating would be the limiting factor.

DISCUSSION:

Necessary Volume

Fig. 1 shows the approximate division of a proprietor's time in a one-man business operation. Fig. 2 itemizes the reduced (lower than normal) operating costs which total $19,800.

Since only 10% is to be added to cover all operating cost, the *base cost* of the total annual volume must then be $198,000. In terms of selling price, the annual volume is determined as follows:

Base cost		$198,000
Operating costs	10%	19,800
Total Cost of Contracts		217,800
Add to profit	10%	21,780
Total Volume (Selling Price) Required		$239,580

Use $240,000 as the annual volume required.

Number of Men

To determine the number of men necessary to handle this volume, break down the $198,000 base cost into its material and labor components. Use the conventional 60/40 material-labor ratio. Then, we would have:

Material	$118,000	(60%)
Labor	79,200	(40%)
Total Base Cost	$198,000	

With a $4.00 per hour labor rate for mechanics, and 2,000 working hours per year, the annual salary per mechanic would be $8,000. By dividing annual base labor cost ($79,200) by the annual salary per man ($8,000) we get 9.9 or an average of 10 mechanics as the number required to handle this volume.

Limiting Factor

Estimating Time is the first and vitally important factor in determining whether a one-man business can handle the volume previously mentioned. Any way you study the problem, this fact is confirmed.

For our analysis, let's use the established "1% of the estimated selling price of the contract" as the cost of the estimator's time (see "A Study of Estimating Costs," page 88, *El C&M*, April, 1960).

The selling price of all contracts (annual volume) is $240,000. Cost of estimating then would be 1% of this, or $2,400. The proprietor of this one-man business does the estimating and his salary base is $5.00 per hour. If we divide $2,400 by $5 we get 480 as the number of hours required to estimate the contracts received. Time also must be allowed for jobs lost.

Normally, a contractor gets about one out of every five jobs he figures. Here, because of the low markups used, we will assume the contractor gets one out of every three jobs he figures. Then, the total time required for estimating all jobs (won and lost) would be 1,440 hours (3 times 480). Compare this with the time allocated to estimating in Fig. 1.

The proprietor (Fig. 1) devoted 11 hours per week to estimating. If he worked 52 weeks of the year, his total allowance for estimating would be 572 hours. This is 868 hours short of the 1,440 hours needed to estimate all the jobs he figures. Even if the contractor worked an extra 15 hours per week to get the estimating out, there still would be the extra engineering, superintending and other work necessitated by the excess volume of business.

Exceptions

There are those who will point out exceptions to the above study. Such exceptions, however, will not be the type of one-man business under study here. One man in an office can handle a large volume of business if he: (1) gets work without competition; and (2) has men in the field who do the engineering, superintending, and much of the purchasing. Such an operation is not the type outlined in Fig. 1 of this discussion.

FIG. 1—A ONE-MAN BUSINESS *

Approximate Division of the Proprietor's Time

ACTIVITY	TIME PER WEEK	
	Percentage	Hours
Administrative	20	8.8
Estimating	25	11.0
Engineering and layout	10	4.4
Superintending	15	6.6
Selling and making contacts	15	6.6
Purchasing	5	2.2
Billing and collecting	5	2.2
Miscellaneous	5	2.2
TOTALS	**100**	**44.**

NOTES: *From ELECTRICAL CONTRACTING, McGraw-Hill Book Co.
There is no formula for allotting a proprietor's time. Such division of time for a new business varies considerably from that for an established firm.

FIG. 2—REDUCED ANNUAL OPERATING COSTS

(Lower than Normal)
For A New Business

Proprietor's salary	$10,000
Bookkeeper's salary	5,500
Rent—including heat	1,500
Electric bills	180
Telephone	180
Depreciation on equipment	150
Interest on investment	120
Auto and travel expense	1,200
Cartage	350
Stationery and insurances	350
Miscellaneous	250
TOTAL	**$19,780**
USE	**$19,800**

FIG. 3—NORMAL OPERATING COST FOR YEAR

Estimated for a One-Man Business

Item	Amount
Proprietor's salary	$14,000
Bookkeeper and general office man	5,500
Rent (heat included)	1,800
Electric bills	180
Depreciation on equipment	180
Interest on investment	150
Telephone	180
Automobile and travel expenses	1,100
Insurance, stationery, and miscellaneous	400
Cartage	300
Reserve for contingencies and guarantee	250
TOTAL	**24,040**

NOTES: Some of the costs here are less than those itemized in Fig 2. Those in Fig. 2 are for a larger volume and direct job costs must be increased.

Primary Distribution Powers a College

Employing corona-resistant, high-voltage cable, a 4160-volt primary system feeds a new multi-building college in Utica, N. Y. Here's a close-up on equipment selection and design details.

AT THE recently completed Mohawk Valley Technical Institute, Utica, N. Y., a primary power distribution system supplies 4160 volts to three relatively distant campus buildings. Here, high-voltage, corona-resistant, single-conductor cables carry power underground from the central facilities to unit substations in each building. With a capacity of over 2000 kva, the electrical system has provisions installed for two future buildings and has ample ability to serve several additional buildings.

Other interesting features include several 10-ft diameter "hanging-garden" lighting fixtures, located at the entrances to each building; the electrical and electronic laboratories; "above-ceiling" lighting in the student cafeteria and lounge; a 2400-volt series street-lighting system; an electronic time and program system that does not need a control wiring network but uses the 60-cycle power circuits to operate.

MVTI, a community college, consists of an Academic building, Student Union building and a gymnasium. The school offers a variety of 2-year courses including Advertising, Banking, Retailing, and Mechanical and Electrical Technology. Each year, this 1200-student school will graduate nearly 500 students fully trained to handle highly technical jobs in industry and other endeavors.

Fig. 1 shows the college campus layout and the 4160-volt distribution. The primary feeder runs are extremely long. From the Academic building to the Student Union building, the run is about 800 ft distant. To the gymnasium, the run is about 1500 ft long.

At 208 volts or even 480 volts, the present and future loads would have required much larger conductors to handle high currents and to maintain proper voltage regulation. In addition, the size and cost of safety switches, circuit breakers and other miscellaneous equipment required at these lower voltages would have been greater. But at 4160 volts, none of these problems were present. Instead, problems centered around selecting efficient 5-kv equipment at an economical cost.

Niagara Mohawk brings 4160/2400 volts, 3-phase, 60 cycles to the primary switchgear located in a

PRIMARY SWITCHGEAR houses load interrupter switches, power fuses and primary metering transformers. Feeders to the Student Union building exit underground. Feeder to the Academic building extends through wall into separate . . .

TRANSFORMER VAULT. Here, the foreman of Rao Electric Equipment Co., electrical contractors, points to three No. 1/0, corona-resistant 5-kv cables carrying power through a 400-amp disconnect switch to a . . .

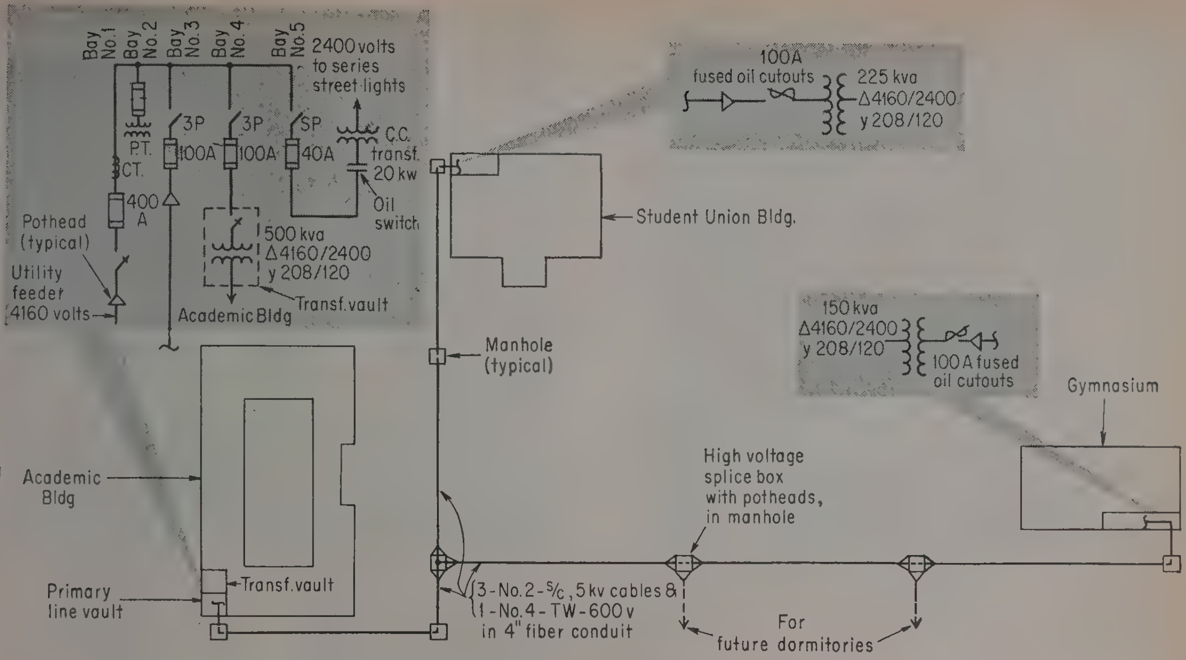


FIG. 1—Diagram shows college campus layout and 4160-volt distribution. From the primary vault to the Student Union building, the run is about 800 ft distant; to the gymnasium, the run is nearly 1500 ft long. Primary distribution practically eliminated voltage-drop and current-capacity problems. Corona-resistant feeders provide added reliability.

vault in the Academic building. Here, the service feeders enter metalclad switchgear, which consists of five bays containing load interrupter switches, power fuses, primary metering transformers and other accessory components. Bay No. 1 (primary main) contains a 3-pole, group-operated, load interrupter rated 600 amps and three 400-amp power fuses. Bay No. 2 is the metering compartment containing current and potential transformers. Bay No. 3, which supplies the Student Union building and gym, and bay No. 4, which feeds the Academic building, each contain load interrupters similar to the main switch and power fuses rated at 100 amps. Supplying the 2400-volt series lighting, bay No. 5 has a load interrupter and 40-amp fuses. The incoming line and the cables to the Student Union building and gym have potheads installed on each conductor.

Three 1/0, single-conductor 5-kv cables and one No. 4, TW ground cables were selected to carry the primary current for the Academic

BANK OF THREE TRANSFORMERS rated at 500 kva. Connected delta-wye, these transformers step down 4160 volts to 208Y/120. Insulators on cable racks support the primary cables; secondary cables are connected to a . . .

VENTILATED BUSWAY rated at 1600 amps, 600 volts. The 3-phase, 4-wire busway has an internal fire stop where it comes through the transformer vault wall to a pull box mounted on top of the main distribution panel.

MAIN DISTRIBUTION PANEL has main breaker rated at 1600 amps. Circuit breakers, rated at 600, 400, 225 and 100 amps, protect the secondary circuits. From here secondary-voltage feeders fan out in . . .

BANKS OF GALVANIZED CONDUIT to various power and lighting panels. Emerging from the pull box are 2½-, 3- and 4-in. conduits. After leaving the basement, practically all conduit is run concealed.

building. From the primary switchgear, these feeders extend in 4-in. conduit into an adjacent transformer vault. Here, the 5-kv cables continue through a 400-amp disconnect switch to a bank of three transformers. Connected delta-wye, these transformers step down 4160 volts to 208Y/120. From this 500-kva transformer bank, the utilization voltage is carried via a 1600-amp, 3-phase, 4-wire busway to the main distribution center located adjacent to the transformer vault. From here, secondary voltage feeders fan out to various power and lighting panels.

From bay No. 3 of the primary switchgear, three No. 2 single-conductor, corona-resistant cables with lead sheaths and one No. 4 TW ground cable extend underground to a high-voltage splice box. Strategically located, this box is installed in a concrete manhole. Here, the cables are spliced, using standard high-voltage splicing techniques and potheads, to form one set of feeders to supply the Student Union building and another set to feed the gym. Two additional 5-kv splice boxes, provided with extra cableheads, are installed in the run to the gym for future buildings.

At the Student Union building, the primary feeders enter underground and continue through potheads and a 100-amp, oil-filled fused switch to step-down transformers located in a separate vault. From the transformer bank, rated at 225 kva, secondary conductors extend in a wire trough to the building distribution board. A similar installation serves the gym, except that the step-down transformers are rated 150 kva.

From main distribution centers in each building, 208Y/120 volts feed various power and lighting panels located near their respective loads. Electrical loads consist primarily of classroom lighting with the heaviest loads concentrated in the Academic building. In the Student Union building, dozens of kitchen electrical appliances plus the cafeteria lighting make up a heavy share of the electrical load. And in addition to having comparatively heavy loads, each building has various outstanding electrical features.

Electronic Time and Program System

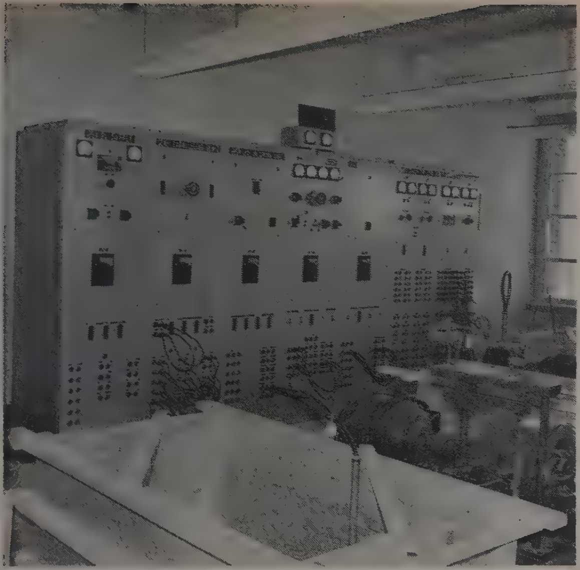
An electronic time and program system automatically corrects clocks and rings class bells according to a preset program. This system follows the carrier-current principle. Power lines are used to carry a high-frequency signal, superimposed on the 60-cycle current, to frequency-selective relays.

A central operations panel, transmitter and coded relays are the major components. "Command" signals, initiated by the central operations panel, are sent to the transmitter, which then generates the high-frequency signal. These high-frequency pulses, carried on the 60-cycle wiring, operate the various coded relays which are capacitively-coupled to 60-cycle power lines. Operated by the coded relays, specific clocks or bells can be group or individually controlled. For example, the output at the central operations panel is set for a certain number of high-frequency pulses. Then, at the proper time, only the relays which are set for that certain number of pulses will operate. In this way, all time signals and bells can be scheduled in advance to ring automatically at the proper time.

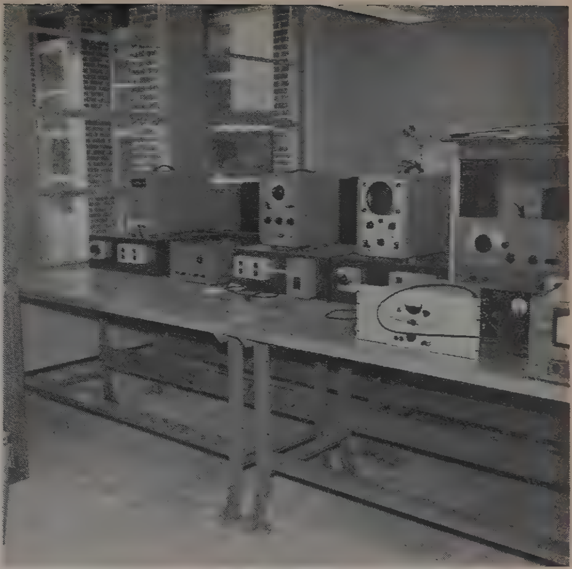
At MVTI, the signal is coupled to 120-volt lines; however, this time and program system can be used on electrical systems up to 44 kv.

Electrical Laboratory

In the electrical lab, students study the application of electrical equipment by actually working on apparatus and through experiments. A specially designed power switchboard delivers 3-phase power at 208 volts or single-phase 120 volts underfloor to M-G sets, experimental tables and to special educational apparatus. Or, through proper connection of jumper plugs on the front of the switchboard, various dc voltages from the lab M-G sets can be obtained.



LABORATORY POWER SWITCHBOARD delivers 3-phase 208 volts or single-phase 120 volts to laboratory M-G sets and to special educational apparatus. Jumper plugs allow students to obtain dc voltages from the M-G sets.



ELECTRONIC LABORATORY equipment includes oscilloscopes, signal generators and power supplies. Test bench provides 120 volts ac and 32 volts dc. Circuit breakers and receptacles are mounted on front of raised platform.

Some of the electrical equipment designed for educational purposes includes dc generators; single and 3-phase M-G sets; a transformer connection panel which assists students in the study of various transformer connections; an amplidyne table, with amplidyne fields and other components in a regulating system brought out and board-mounted. The open-board arrangement of the amplidyne table not only facilitates understanding of regulating systems, but also allows the student to make connections and test measurements easily.

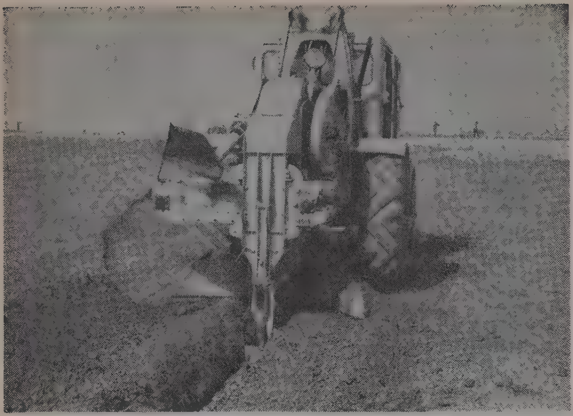
Electronic Laboratory

Electrical students receive training in industrial and communication electronics. In the electronic laboratory, they learn how to use various test equipment including oscilloscopes, signal generators, and volt-ohmmeters. This equipment is installed on benches, which have 208Y/120 volts ac and 32 volts dc supplied underfloor to each bench. Circuit breakers protect each circuit at every bench. Breakers and receptacles are within easy reach of the student yet their location does not take up useful space because they are mounted on the face of a raised platform. (See accompanying photo.) Thus, when several instruments must be grouped during

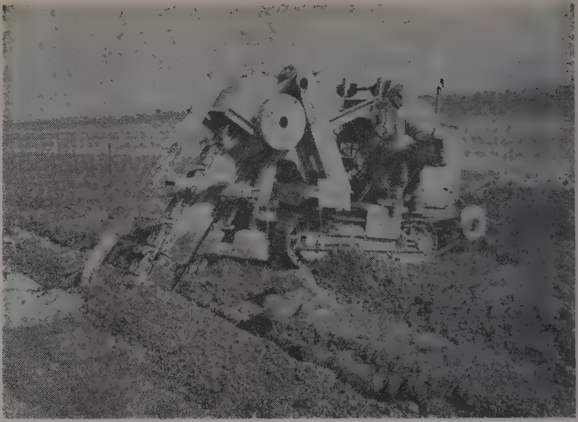
(Continued on page 184)

DRAPED CEILING in the Student Union building cafeteria consists of hundreds of small concave disks (see insert); has 162 floodlamps, rated 150 watts, mounted about 1 ft above the ceiling.

HANGING GARDEN light fixtures illuminate entrances at each building. Fixtures are also planters. In warm weather, ivy or other similar green plant life will hang from perimeter of the fixture.



HEAVY DUTY TRENCHER cuts a clean 10-in. by 30-in. trench in turf median strip; piles dirt alongside trench. Under normal conditions, unit can cut about 350 ft of trench per hour.



LATERAL TRENCHES connecting opposite standards in median strip are cut by smaller cat trencher with better maneuverability. On straight-away, unit reportedly can cut about 250 ft of trench per hour.

Machines Speed Underground Cable Work

Wood Electrical Construction, Inc., combines judicious use of machines with efficient field crew organization to accelerate trenching and cable laying at Chicago's O'Hare International Airport.

REEL TRUCK follows sand spreader's first pass. As truck moves along road, mechanics pull off required number of cables and lay them in the trench. Truck carries six reels of Type USE direct-burial cable.

TEAMWORK involving men and machines is a key to electrical construction progress at the multi-million dollar expansion of jet aircraft and passenger facilities at Chicago's O'Hare International Airport. To meet the comparatively tight schedules and precise specifications of Naess & Murphy, architects and engineers for the expansion project, electrical contractors are constantly evolving new techniques to accelerate installation.

Typical of advanced methods in evidence is the mechanized approach of Wood Electrical Construction, Inc., Chicago, contractors for roadway lighting (among other items) at the project. Wood management makes judicious use of power equipment (see accompanying photos) for trenching, cable installation and backfilling. But

BACK-HOE on tractor-shovel excavates for pipe-pushing equipment at points where lighting circuits go under roadway. Same unit is used for backfilling and grading.

SAND SPREADER follows trencher to deposit 4-in. layer of sand on trench bottom; returns after reel truck to add another 4-in. on top of cables. Mechanic moves conveyor end-plate to distribute sand over trench width.

that is not all. Equipment operation is programmed to fit a predetermined sequence followed by an efficiently organized field crew.

The multiple-lane concrete entrance and exit roadways are separated by a wide turf median strip. Conventional street lighting standards on concrete bases line both sides of the roadways. Direct-burial cables for lighting circuits are installed in trenches in the median strip and roadway shoulders.

Installation followed this step-by-step procedure:

1. A heavy-duty, rubber-tired, trencher dug a 30-in. deep, 10-in. wide trench down one side of the median strip close to one line of standards.

2. A lighter, caterpillar-tread trencher cut 30-in. by 8-in. lateral trenches between opposite standards in the median strip.

3. At points where circuits went under the roadway, a tractor-shovel with back-hoe excavated for conduit-pushing equipment.

4. Behind the trenchers came a sand-spreader truck with lateral belt conveyor to direct 4 in. of sand into the bottom of the trench.

5. A reel-truck followed the sand spreader. As the truck moved down the road, mechanics pulled off the required number of No. 4 and No. 6 conductors and laid them in the sanded trench.

6. The sand spreader backtracked and followed the reel truck pouring another 4 in. of sand on top of the cables.

7. After about 12 in. of dirt was hand backfilled (to eliminate large stones and sharp objects) a mechanic with a gasoline-driven tamper compressed the fill to about 85% compactness. A second layer of backfill was added and tamped to about 95% compactness.

8. The top layer of black topsoil was pushed into the trench by a tractor shovel which continued with final grading.

By repeating this cycle on each section of the project, Wood mechanics installed the job with clockwork precision. The full capabilities of men and machines were realized with an efficiency that can be attained only through a well-coordinated field organization such as displayed on this installation.

TAMPERS ARE USED to compact earth backfill placed on top of sand. First layer is hand backfilled to eliminate large stones and sharp objects which might damage cables.

FINAL BACKFILL and grading is done with tractor-shovel. Hydraulically operated back-hoe on unit is used to dig large excavations when required.

A practical approach to . . .

Troubleshooting Electronic Speed Controls

Here's a basic analysis of a typical electronic motor speed regulator plus the latest techniques for effective troubleshooting and maintenance.

By **A. P. Jacobs**, *Industrial Application Engineer, General Electric Co., New York, N.Y.*

SYSTEMATIC TROUBLESHOOTING PROCEDURE

Step 1. Make a visual inspection for:

1. Open line switch, blown fuses, tripped overload or other protective relays
2. Burned-out tubes
3. Damaged or discolored components or loose connections
4. Overheating, binding or foreign material at motor or driven load
5. Misadjustment of initial control settings.

Step 2. Test or replace tubes. Use only known good tubes for replacement. Tube complement may include:

1. Thyratrons for armature control
2. Thyratrons for field control
3. Rectifiers for dc control power
4. Rectifiers for current limiting and IR compensation
5. Voltage regulators for dc control
6. Amplifiers for field and armature control.

Step 3. Localize trouble to:

1. External lines or protective equipment
2. Magnetic control devices
3. Motor or driven load
4. Armature-power or field-power speed-control circuits
5. Control circuits (dc supply, voltage regulators, amplifiers, phase-shifting circuits).

Step 4. Make voltage and resistance tests. Use high-impedance meter. Compare readings obtained to:

1. Manufacturers given voltage and resistance values or to
2. Readings taken when system was operating normally.

ELECTRONIC troubleshooting need not be a tedious, drawn-out procedure. On the contrary, if the plant electrician has developed a systematic approach, it will be no more difficult than conventional electrical troubleshooting.

This article presents a practical, systematic approach to troubleshooting a typical electronic adjustable-speed drive. And, with some variations, the principles discussed here can be applied to other types of electronic equipment.

The approach entails three phases: (1) a general theoretical understanding of equipment functions to facilitate rapid localization of trouble, (2) general information of pertinent electronic circuitry, (3) practical "common-sense" troubleshooting techniques.

To serve as the example unit to be analyzed, a high-performance thyratron control adjustable-speed drive was selected. This speed variator is a packaged electronic-rectifier motor speed controller that operates from standard ac power and provides for adjustable regulated speed. And because feed-back signals from the motor govern thyratron rectifiers in both the armature and field circuits, speed control is extremely accurate.

Ranging from ¾ hp to 10 hp, these units are ideally suited for control of industrial process drives such as pumps, conveyors, reels, machine tools, test apparatus and any other equipment that must have stepless speed control over a wide range with accurate speed regulation. In addition to starting, stopping and regulating the motor speed, the control also provides overload protection, current-limit control, IR-drop compensation, dynamic braking, undervoltage protection and acceleration to a preset speed.

Drive Components

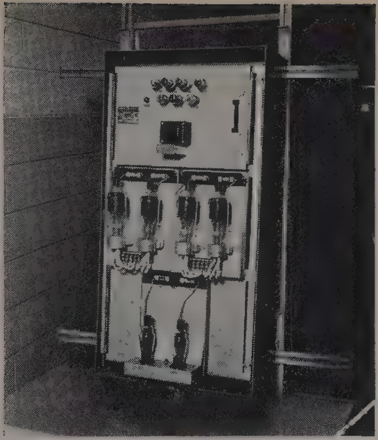
The drive consists essentially of the following four main items:

1. A shunt-wound dc motor.
2. A pushbutton type control station incorporating a speed-setting potentiometer.
3. An anode transformer to supply correct voltage levels for thyratron and control-tube operation.
4. Main control panel including armature-and field-thyratron rectifiers, and the vacuum tubes and other components used to control the output of the thyratrons.

Drive Operation

Perhaps the best way to understand the operation of this drive is to examine the functional block diagram shown in Fig. 1. At first glance, even this simplified diagram might seem complicated. But, as with all equipment of this type, if this drawing is studied in small sections, it becomes quite easy to tie all sections together into a complete system.

In the armature section (top portion of the diagram) an armature-voltage feedback signal and an armature-voltage reference signal are compared at the input to the dc armature amplifiers. The feedback signal taken from the motor's armature line represents the actual motor speed. Derived from the speed-control potentiometer, the reference signal represents the desired speed. The difference between these two signals, that is the error voltage representing the deviation from desired speed, is fed into the dc armature amplifiers. These amplifiers control the output of the armature rectifiers, which in turn correct the speed of the dc motor. When the speed of the motor reaches the speed called for by the speed potentiometer, the error voltage goes to nearly zero. As a result, the armature rectifier output voltage remains constant. Thus the speed of the motor is held constant. Field control circuit operation is similar.



ELECTRONIC SPEED-CONTROL PANEL is shown with cover removed. Control tubes, mounted at top, include voltage regulators, rectifiers and amplifiers. Armature thyratron tubes at center are protected by 15-amp, non-renewable fuses. Field thyratrons are at bottom.

Fig. 2 shows a more complete block diagram giving locations of principal circuit functions. Note that the dc amplifiers are now shown feeding into phase-shifting circuits. By varying the control current into saturable reactors connected in the phase-shifting circuits, the firing of the thyratrons can be varied. This varies the average dc output voltage of the rectifier circuits, which results in variable control of the motor speed.

Also note the addition of the regulated rectifiers and armature current-measuring circuits. The regulated rectifiers afford a constant voltage source for reference voltages and for proper operation of the amplifiers. Current-measuring circuits provide a current signal to compensate armature-rectifier voltages for changes in load. This current signal also limits the output current of the rectifiers during acceleration of the motor.

In addition to these electronic circuits, several magnetic control devices are necessary for protection and proper operation of the system. A timer allows tube filaments to warm up before tube plate current is allowed to flow. A field-loss relay prevents starting the motor without field voltage and, if field power fails during operation, it shuts down the equipment. A dc contactor and an overload relay are also incorporated.

Circuit Analysis

For electronic troubleshooting, it isn't necessary to possess a thorough knowledge of electronic theory. However, it would be advantageous to have a general knowledge of circuit components, their uses, and a basic understanding of individual tube circuits. Following is a brief explanation of the armature speed-control circuit shown in Fig. 3.

Thyratron Circuit

Tubes T1 and T2 are the armature rectifiers which conduct on alternate half cycles. Current flow (when T1 is conducting) is from the plate of T1 up through the current transformer, through the center-tap of the anode transformer, down to bus 2, and up through the motor and main contactor M completing the circuit at the cathode of T1.

Control Circuit

Tubes T3 and T4 provide amplified "command" signals to the phase-shifting circuits. A reference voltage from the speed-control potentiometer is applied to the control grid of T3 through resistors R5 and R6. Feedback voltage from the motor armature is also applied to the grid of T3 through resistors R3 and R4. The resultant difference voltage at the grid of T3 is amplified, then applied through R10 to the control grid of T4. T4 further amplifies the signal and, from T4, this amplified voltage controls the phase-shifting circuit, which in turn controls the output of both T1 and T2.

Tube T5 is a full-wave rectifier that supplies the necessary dc voltage for the control tubes and phase-shifting circuit. Current flow (for a half cycle) is from one plate of T5, through the center-tap of the transformer, down to bus 1, up through voltage-regulator tubes VR2 and VR1, through R13 and filter reactor L1, completing the circuit at the cathode of T5.

Voltage-regulator tubes VR1 and VR2 afford constant voltage levels for reference voltages and for proper operation of the amplifiers.

Tube T6 rectifies armature voltage from the current transformer to provide feedback for the IR compensation circuit. Current flow is similar to that described for T5.

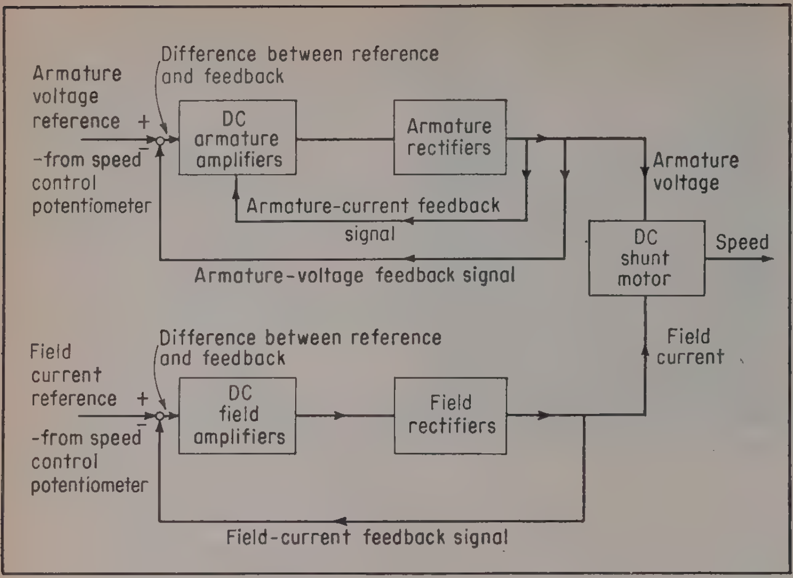

Armature voltage reference +
Difference between reference and feedback
-from speed control potentiometer
DC armature amplifiers
Armature rectifiers
Armature-current feedback signal
Armature voltage
DC shunt motor
Speed
Armature-voltage feedback signal
Field current reference +
Difference between reference and feedback
-from speed control potentiometer
DC field amplifiers
Field rectifiers
Field current
Field-current feedback signal

FIG. 1—Simplified diagram shows speed-control principle. Voltage signal from the dc motor armature, which represents actual motor speed, feeds back to the input of the dc amplifiers where it is compared with a reference voltage, which represents desired speed. The difference between these two voltages, which represents deviation from desired speed, is amplified to control the armature rectifiers, which in turn correct motor speed. Field control circuit operation is similar.

Practical Troubleshooting

Most troubles encountered in electronic control circuits will be relatively simple. A blown fuse, a tripped protective relay or a burned-out tube are common causes of failure. On the other hand, unusual malfunctions of the equipment can and do occur. However, before entering any troubleshooting procedure, make a visual check of the following:

1. External connections for breaks or bad connections.

2. Line switch and fuses for burning, discoloration or open fuse.

3. Overload and protective relays and control fuses to see if they have functioned.

4. All tubes to see if they light.

5. Motor and driven load for overheating, binding or foreign material.

6. Resistor pigtails, terminals, and connections for burning or for loose connections.

7. Resistors, capacitors, transformers for discoloration.

8. Initial set-up adjustments to see that they have not been inadvertently changed.

Also, you should add additional check points or other quick tests that are pertinent to your own equipment.

By following this visual check list, you will usually find the trouble quickly thereby saving many hours of lost production. If these checkpoints fail to locate the trouble, the malfunction must be localized using a systematic procedure.

Perhaps the most important step in troubleshooting electronic equipment is to isolate the trouble to a particular portion of the equipment.

For example, if the motor will not start it will be necessary to check each circuit and eliminate sections until the faulty portion is isolated.

In this case, first check the magnetic circuits to see if the line switch is open, fuses are blown or if the motor overload relay has tripped. If by pressing the start button, the main contactors pick-up and relays operate properly, this section may be eliminated. Next, check the power circuits to determine if there is a blown anode fuse or a defective armature- or field-thyratron tube. If the trouble is still present, then the control circuits should be checked. Here it is best to replace all control vacuum tubes one at a time with known good tubes until the defective tube is found. Remember, that even with a defective control circuit, the line contactors may pick up when the start button is pressed, and the field tubes may glow.

For another example, suppose there was no control over speed. First, make a visual inspection of both the armature and field control circuits looking for a charred or otherwise visibly damaged component. Next, replace control and thyratron tubes with known good tubes, always allowing time for the tubes to heat. If this does not clear up the malfunction, it will be necessary to check the circuit continuity by taking voltage and resistance checks of the speed-control circuit.

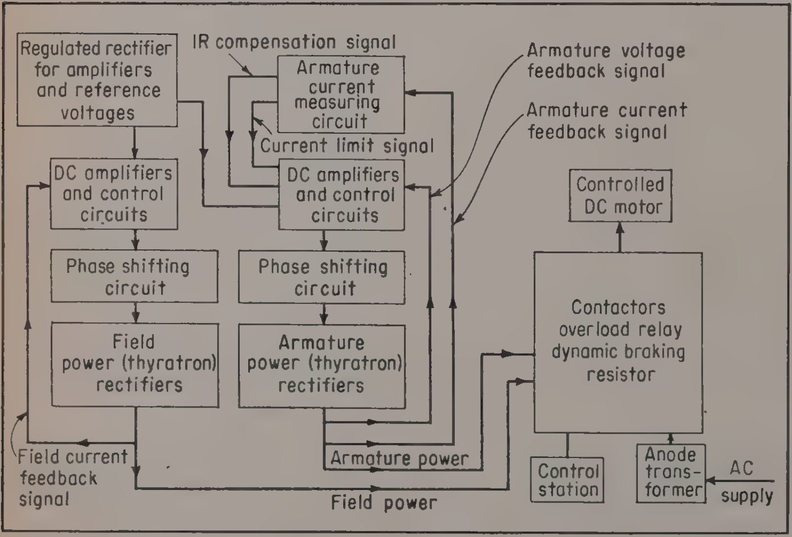

Regulated rectifier for amplifiers and reference voltages
IR compensation signal
Armature current measuring circuit
Current limit signal
Armature voltage feedback signal
Armature current feedback signal
DC amplifiers and control circuits
DC amplifiers and control circuits
Controlled DC motor
Phase shifting circuit
Phase shifting circuit
Contactors overload relay dynamic braking resistor
Field power (thyratron) rectifiers
Armature power (thyratron) rectifiers
Field current feedback signal
Armature power
Field power
Control station
Anode trans-former
AC supply

FIG. 2—Complete block diagram shows sections of a typical speed-control system. Phase-shifting circuits are required to vary output of the thyratrons. Regulated rectifiers afford a constant voltage source for amplifiers and reference voltages. Armature current-measuring circuit provides signals to limit current flow and to compensate armature-rectifier voltages for changes in load.

How Voltage Checks Localize Trouble

Correct voltage and resistance values are usually given in the manufacturer's instruction book. Comparing these values with actual test readings will usually lead to the source of trouble. For example, if the voltage chart indicates that the value at the plate of T3 (Fig. 3) should be 100 volts and tests reveal a very low voltage or perhaps zero, one cause of the trouble might be an open plate resistor, R11. An ohmmeter check of this resistor should then be made to verify this finding.

If voltage and resistance values are not supplied by the manufacturer, it is well worth your time and effort to record normal operating voltage and resistance readings for future use.

Circuit Testing Equipment

Since many electronic circuits have a very high impedance, meters having high impedance are required to obtain accurate readings. A radio-service multimeter having a resistance of 20,000 ohms per volt or higher can be used in most instances. For measuring low grid voltages or other low-energy, high-impedance circuits, a cathode-ray oscilloscope or a vacuum-tube voltmeter will prove extremely useful.

Preventive Maintenance

All portions of the equipment should be inspected at regular intervals. The equipment should be cleaned, removing any dust, oil or foreign matter which may have accumulated. In addition, check terminals and leads that might loosen. Transformers, fuses and other components should be examined for signs of overheating, such as scorching, blistering or leaking of insulating materials. Also inspect the drive motor, contactors and protective relays. Inspection records should be kept noting any deviation from normal, work done and parts replaced.

If the drive has been operating satisfactorily, it should be sufficient to inspect the tubes visually. However, some users prefer to check all vacuum tubes periodically with a tube checker and discard those which give below standard indications. Others leave tubes in place as long as the drive performs properly. All filaments should be checked to see that they light. Thyratron tubes should exhibit their characteristic blue or purple glow and should shut off momentarily when the speed-control knob is turned rapidly from a high to a low speed setting. The voltage reference tubes should glow continuously after the unit has been turned on.

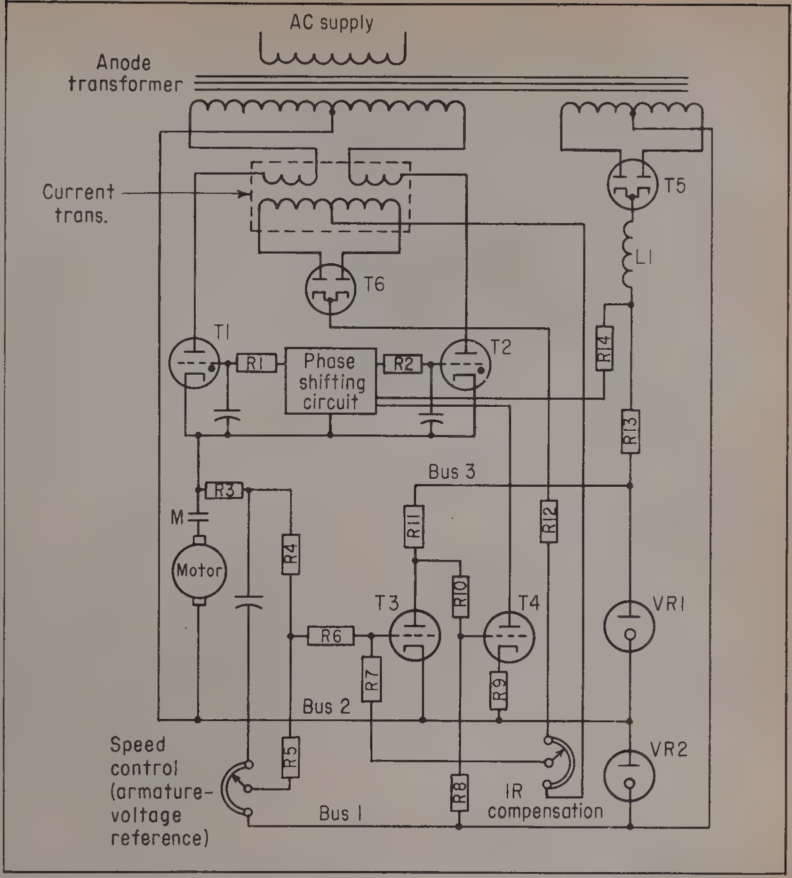
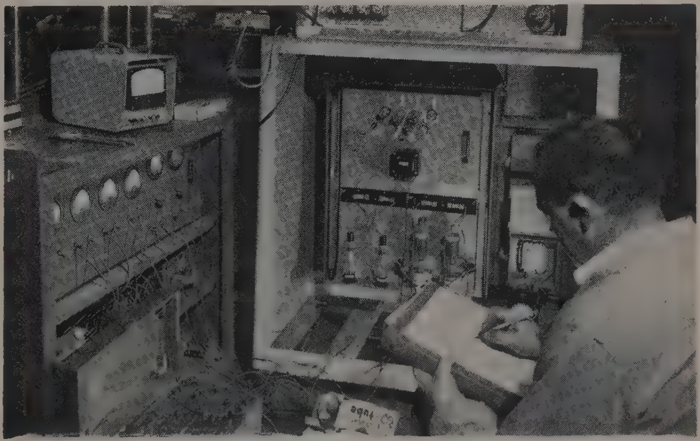


FIG. 3—Armature speed-control circuit includes armature thyratron tubes T1 and T2. T3 and T4 are the control amplifiers. T5 is a rectifier tube supplying dc power to control circuits. To provide a constant voltage source for the amplifiers and reference voltages, gas tubes VR1 and VR2 are provided. T6 rectifies the armature current for the armature current-measuring circuit.



VOLTAGE AND RESISTANCE readings are recorded by technician for future reference. A high-impedance multimeter should be used to obtain readings. Equipment on truck at left includes a custom meter panel and a vacuum-tube voltmeter. On floor, decade box allows substitution or comparison of resistance and capacitance values.

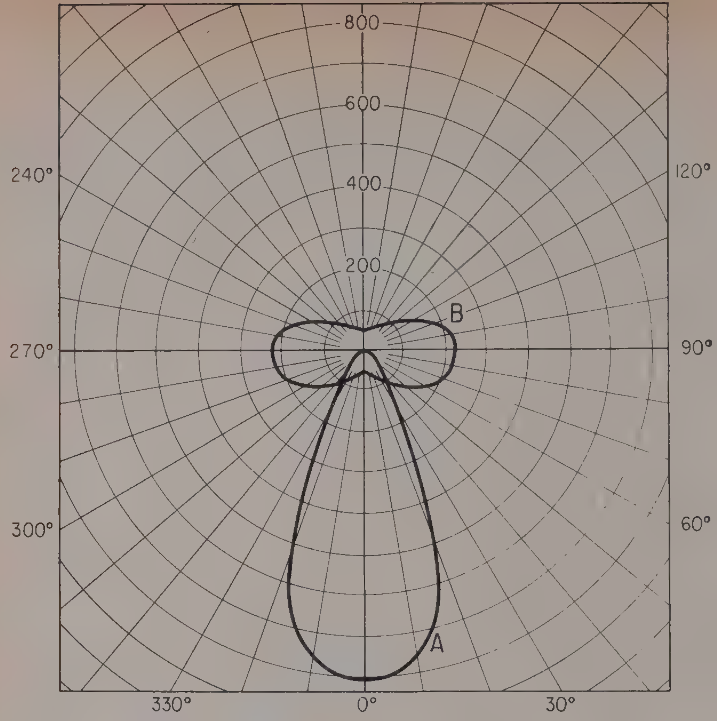


FIG. 1—Two typical light distribution curves. Light output for luminaire B is double that of luminaire A.

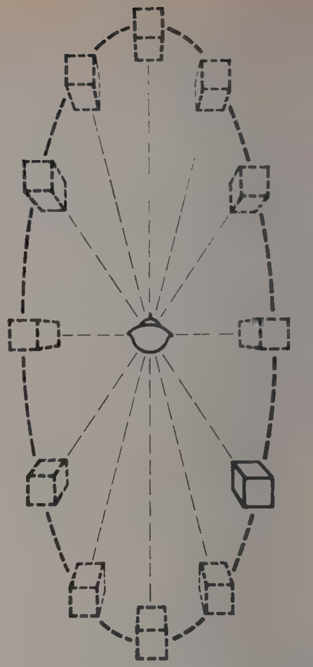


Fig. 2—Photocell is rotated arou
luminaire at a specific distance to mea
ure footcandles at specified angles.

Interpreting

Light Distribution

The control and distribution of light by a luminaire is revealed b its photometric light distribution curve. The following pointers w be found helpful in reading and interpreting these curves.

By Willard Allphin, *Illumination Research, Sylvania Lighting Products, Salem, Mass.*

PHOTOMETRIC distribution curves for luminaires are done in a special "language" which can tell a good deal if properly interpreted, but are sometimes misunderstood by those who have occasion to use them. For example, the distribution curves for two incandescent luminaires are shown in Fig. 1. If it seems to you that luminaire A must be giving more light than luminaire B, you had better read the rest of this article. If it is clear to you that luminaire B is giving more light (it's actually twice as much), then you may be excused; you don't need the lesson.

To show why such appearances can be deceptive, it is important to consider how such curves are constructed, and what they really mean.

For the sake of simplicity, first consider an incandescent luminaire of the enclosing globe type. This luminaire is symmetrical about its vertical axis, so one curve can be used to show the light distribution. If there are any small differences in brightness around the circumference of the luminaire, these differences are averaged out. In actual practice, the averaging is done by rotating the luminaire on its axis while it is being measured.

Illumination is measured by a photocell, as shown in Fig. 2. The photocell usually swings around the luminaire on a long arm, and alway
faces the luminaire. Sometimes th
photocell is stationary, and th
luminaire is rotated, in order
present different angles to th
photocell. At regular intervals, suc
as 10° of angle, the footcandles a
measured. Multiplying these by th
square of the distance gives th
candlepower in the direction towa
the cell. This value for each ang
is then plotted on a piece of pola
coordinate paper, as shown in Fi
3. On polar coordinate paper, th
circles can be marked in any uni
such as candlepower, so that th
greater the distance from the ce
ter of the chart the greater the ca
dlepower indicated.

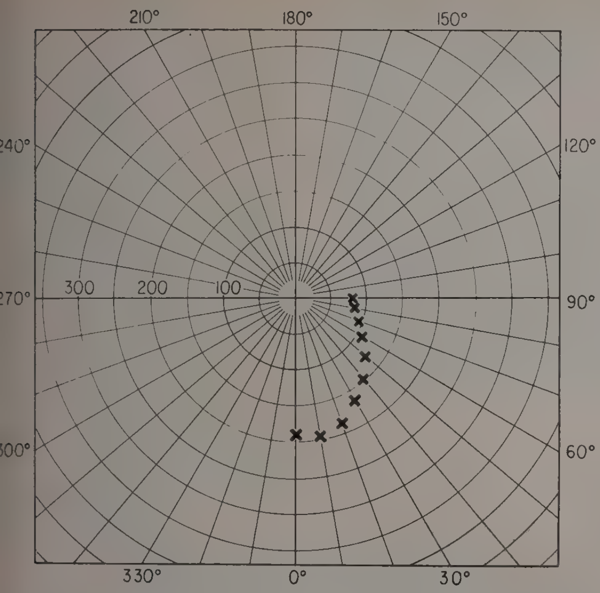


FIG. 3—Candlepower values computed from footcandle values at each angle are plotted on polar coordinate graph.

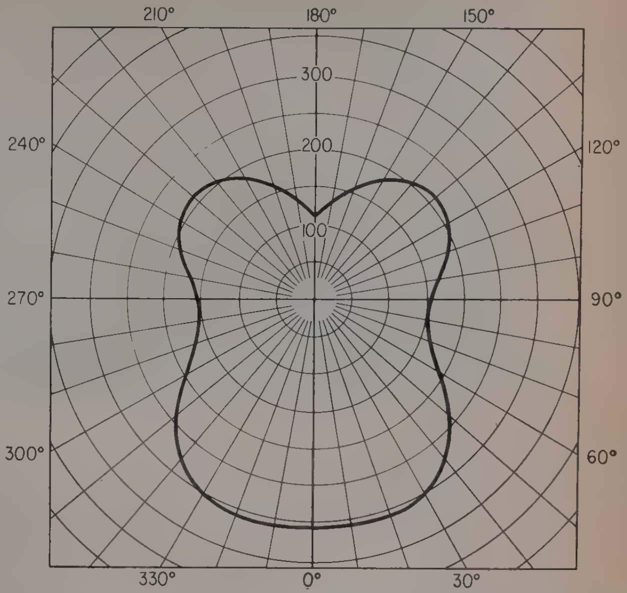


FIG. 4—Typical candlepower distribution curve for a general diffuse type of luminaire.

Curves

When measurements have been made from 0° to 180°, the points are connected by a smooth curve. The curve is duplicated from 180° to 360° in the example chosen because the luminaire is symmetrical. The curve is called a photometric light distribution curve, or a candlepower distribution curve, for the luminaire, and a typical one is shown in Fig. 4.

All parts of the curve are not of equal weight in adding up the lumens. Consider a sphere with bands drawn inside it, as shown in Fig. 5. These are like the imaginary lines of latitude on the earth. If the lines are drawn 10° apart, the bands will all have the same width on the periphery of the sphere, but they will not have the same length. Therefore each band in a hemisphere will have a different area.

Applying this concept to the curve in Fig. 4, the candlepower intensity at the center of any 10° angle can be read, and from this it is possible to calculate the illumination at the center of that band.

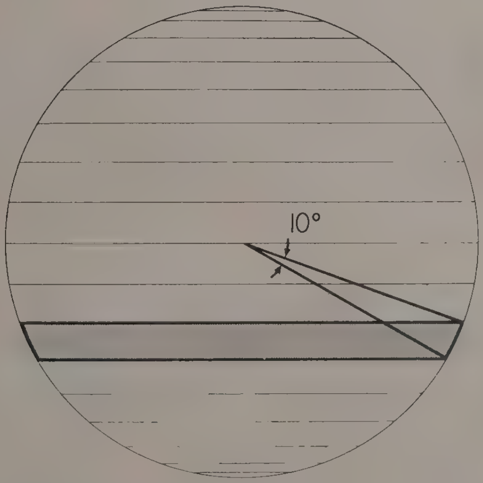


FIG. 5—All bands formed by 10° angles have same width at perimeter of sphere, but length of bands vary, and so does area of each band.

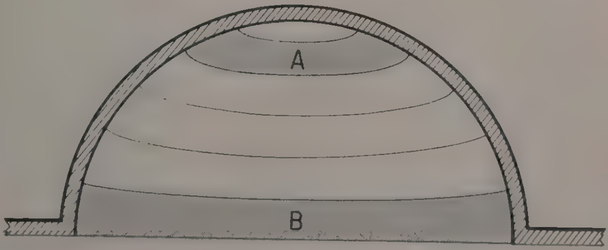


FIG. 6—Area of band A in ceiling dome is less than that of band B, even though width of each band is the same.

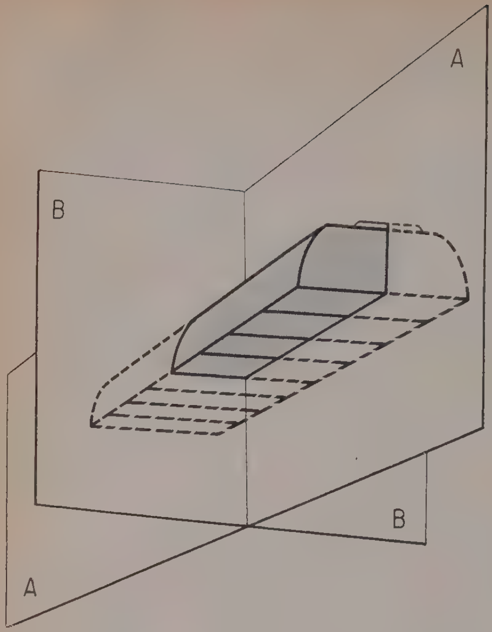


FIG. 7—Photometry of fluorescent luminaires involves candlepower values at various angles in plane "A-A" and plane "B-B" passed through the luminaire as shown.

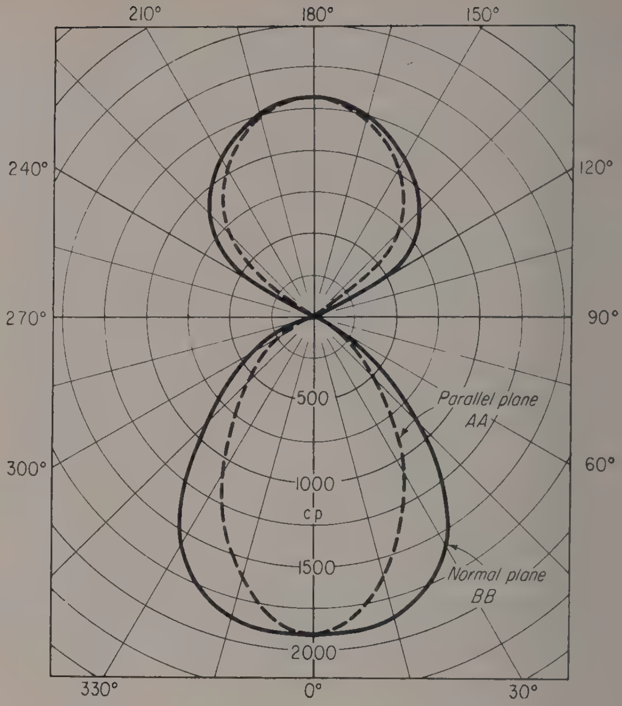


FIG. 8—Typical light distribution curves for general diffuse type fluorescent luminaire, developed as shown in Fig. 7.

The illumination in footcandles, multiplied by the area of the band, in square feet, will be the total lumens to that band, or zone.

When the lumens to each zone in the upper hemisphere have been calculated, they are added, and the result is the total upward lumens from the luminaire. Likewise, the sum of the lumens to all zones in the lower hemisphere gives the total downward lumens from the luminaire. Adding the upward to the downward lumens gives the total lumen output, and this value, divided by the lamp lumens, represents the efficiency of the luminaire. For example, suppose the measurements had been made with a 200-watt incandescent lamp producing 3800 lumens, and the lumens from all the zones add up to 2970. The efficiency of the luminaire would then be—

$$\frac{2970}{3800} = 0.78, \text{ or } 78\%$$

Now consider the misinterpretation of Fig. 1, mentioned at the beginning of this article. With normal curves and charts, it is the area under the curve, that is, between the curve and the base line, that has significance. In the case of candlepower distribution curves, however, the area enclosed by the curve does not have direct meaning. It is difficult to avoid the feeling that the luminaire showing in curve A of Fig. 1 is giving more light than the one in curve B, because curve A encloses the larger area on the chart. Actually luminaire B has twice the lumen output of luminaire A. Curve A has some higher candlepower values, but remember that these represent lumens going to the lower zones, where the zonal areas are smaller. From 35° upward, curve B shows higher candlepower values, and these occur where they count heavily from a zonal standpoint.

It may help to think of a painter working on the inside of a dome, as in Fig. 6. If he paints the dome in a series of bands having the same width, it will take much more paint to do the lower zones than the upper ones. As can be seen, the lower zones are much longer, since they are at the center of the sphere.

The photometry of fluorescent luminaires is more involved, because the luminaires are not symmetrical about a vertical axis. However, the basic principles are the same. First a distribution curve is obtained for values in a plane A passed through the luminaire parallel to its long dimension, as in Fig. 7. Then values are obtained for a plane B, at right angles to the long dimension. Fig. 8 shows the candlepower distribution curves which might result for a particular luminaire. Planes are also passed at an angle of 45° to the first two in order to give a more complete picture of where all of the lumens go. The parallel and perpendicular planes are usually the only ones published for general use, but the 45° planes are used in addition to the other two for developing the coefficients of utilization for the particular luminaire.

Another use for such curves is in calculating by the "point-by-point" method. This is tedious and is seldom used, so it will not be detailed here. In brief, it permits calculating the illumination from a single luminaire at any point in space.

Since the lighting engineer is unlikely to make point-by-point calculations, and since coefficients of illumination are already provided for him by the lighting equipment manufacturer, the principal value of a photometric light distribution curve is in giving a rough idea of where the light goes. For example, one can tell by looking at Fig. 8 that the luminaire sends light both upward and downward, and that there is a "cut-off" of the maximum brightness at about 65° for the normal plane.

GHT VIEW of Grandview Plaza opping center shows the parking which is well lighted by two amp (1500-ma 8-ft fluorescent) minaires mounted on each stand-d.

lectrical details in . . .

Wiring a Shopping Center

A roundup of design and construction techniques used for lighting and distribution circuits in Grandview Plaza Shopping Center, Phoenix, Ariz.

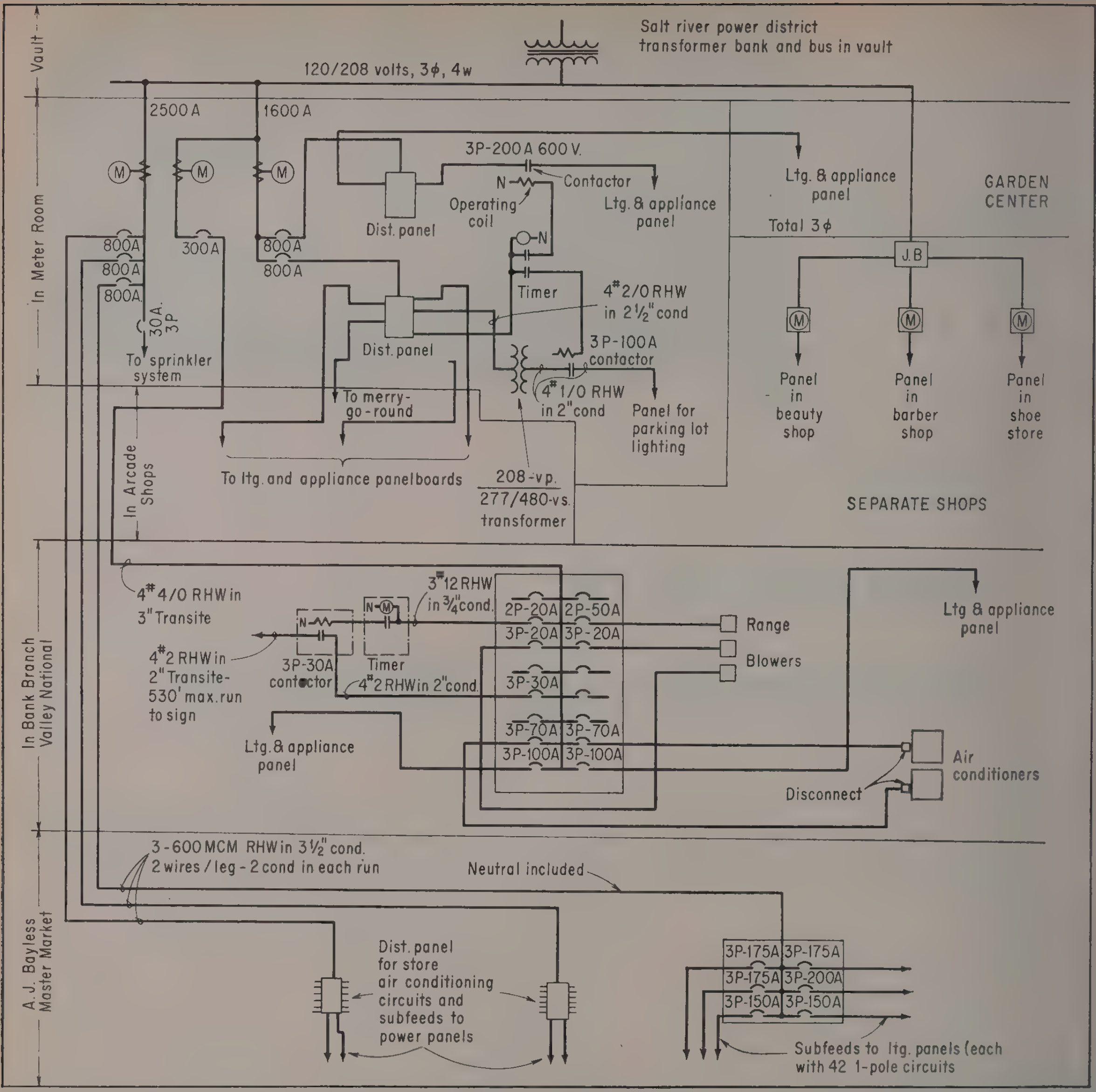
By W. B. Keller, *P. E., The Keller Engineering Co., Inc., Phoenix, Ariz.*

EFFECTIVE LIGHTING in this area of the supermarket is provided by a number of lighting sources: 1) the 4-tube, continuous row, general fluorescent lighting on the ceiling; 2) the sign lighting; 3) the surface-mounted incandescent units over the fountain area; and 4) a fluorescent row at the rear of the fountain area.

CLOSE correlation of engineering factors and economic limitations was the key to electrical design for this Phoenix shopping center. A study of some of the job details indicates how careful design can provide high-level of electrical utilization from an economy-oriented system.

This shopping center of 56,000 sq ft consists of two major building units—an arcade of six to ten small stall shops in one unit and six stores of the service variety in a larger second unit. The heating and air conditioning system for the entire area is an all electric heat pump installation.

The main store, operated by the A. J. Bayless Markets, is unique for its size and function. It consists of the largest supermarket of the Bayless organization, with a large



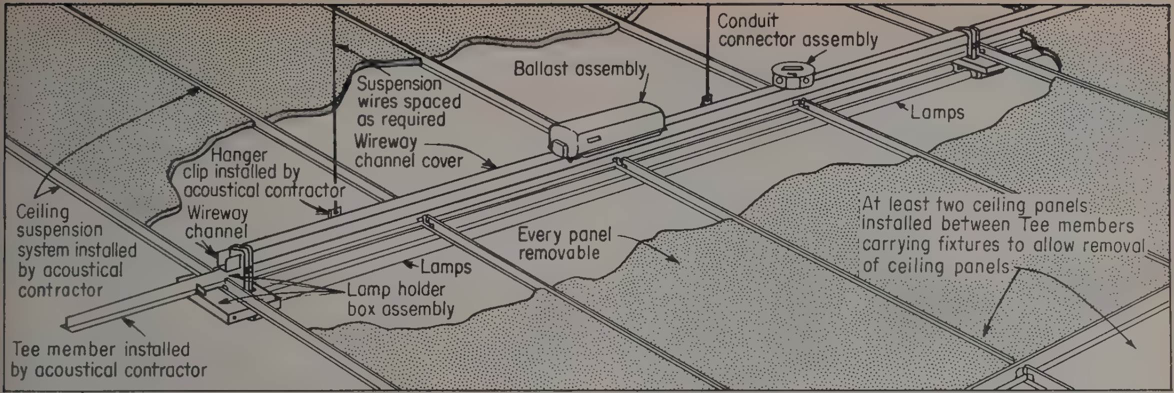
ONE-LINE DIAGRAM of distribution for the shopping center shows the basic load break-downs for the 120/208-volt system. Note the use of step-up transformer to supply 480/277-volt energy for the parking lot luminaires. Magnetic contactors, with their coils actuated through time switches, provide automatic control of parking lot lighting, sign lighting and building lighting. Note the use of No. 2 conductors to minimize voltage drop in 30-amp circuit to the bank sign.

variety store, drug store, and lunch counter all logically and harmoniously woven together in one vast area 160 ft by 264 ft. Besides the counters and display cases, the only other obstruction within this entire area is the single row of structural supporting columns that divide the building lengthwise and support the adjacent ends of each of two string trusses that form the roof framing.

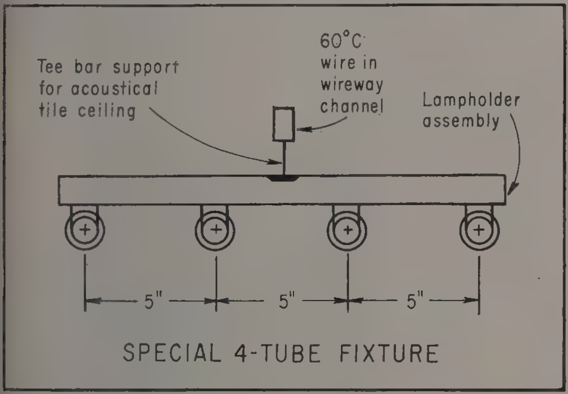
Where the two 80-ft bow-string trusses for the roof converge at the center, a covered and ventilated access area running the entire length of the market makes an ideal location for the air conditioning equipment and other services.

The electrical distribution was designed with adequate wiring standards in mind and very careful consideration was given to wire sizes supplying all of the electrical loads including the parking lot lighting, signs, directories, and decorative lighting. The over-all project is served with a 120/208-volt, 3-phase, 4-wire electrical distribution system because much of the electrically powered and driven equipment used in the market area was not readily available for operation at higher voltages. The size and layout of the project made voltage drop calculations extremely important at the 120/208-volt level.

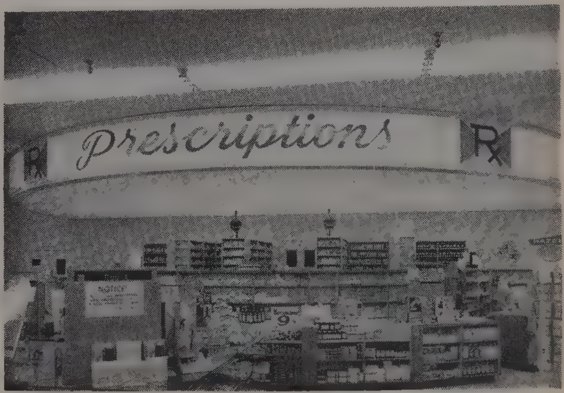
The integrated suspended-ceiling system was selected for over-all reduction of installation costs and to help reduce the air-conditioning requirements. By using the tee-bar grid for the acoustical panels and lighting fixture mounting, with the wiring trough and ballasts mounted on the top of the tee in the space above the sales area, it was possible to reduce the heat produced by the lighting system in the sales area proper by almost 25%. This reduced the air conditioning require-


Conduit connector assembly
Ballast assembly
Suspension wires spaced as required
Wireway channel cover
Lamps
Hanger clip installed by acoustical contractor
Ceiling suspension system installed by acoustical contractor
Wireway channel
Every panel removable
At least two ceiling panels installed between Tee members carrying fixtures to allow removal of ceiling panels
Lamps
Lamp holder box assembly
Tee member installed by acoustical contractor

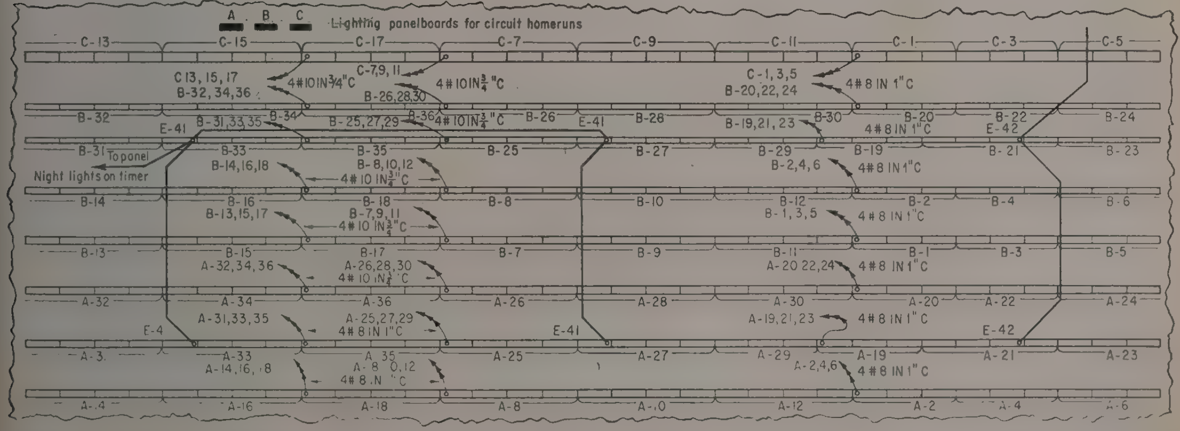
CONSTRUCTION DETAILS of the integrated acoustical ceiling and lighting system. The ceiling system incorporates the necessary fittings to provide for surface-mounted fluorescent lighting. With this system, layout is fixed and luminaires are automatically aligned. Mounting of the ballasts in the plenum above the ceiling provides better ventilation of the ballasts than when they are installed in the channel. This provides longer life and lower maintenance for ballasts. And ballast hum and heat are isolated from the store space below the suspended ceiling.


Tee bar support for acoustical tile ceiling
60°C wire in wireway channel
Lampholder assembly
5"
5"
5"
SPECIAL 4-TUBE FIXTURE

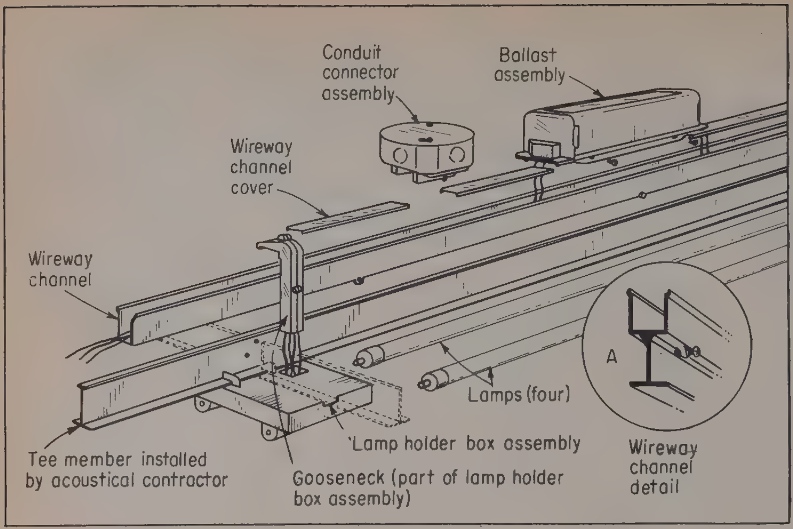
SPECIAL FIXTURE requested by the electrical system designer is a variation on the basic unit provided by the manufacturer. Wider center-to-center spacing of the tubes provides greater light output and larger-area, lower-brightness of the continuous row sources.



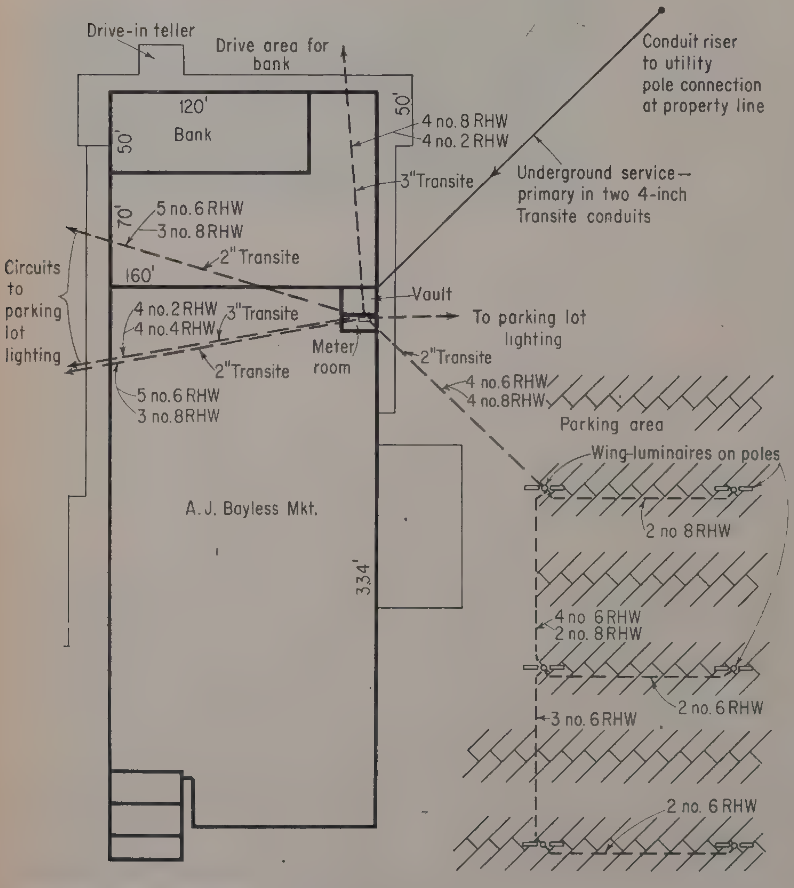
150 FOOTCANDLES was the initial average intensity provided by the continuous-row, general-area fluorescent lighting—which should eventually provide a maintained level of 125 footcandles. Note the location of the lampholder boxes on spacings of two tile widths, to take 8-ft. lamps.



BRANCH CIRCUIT WIRING in this partial plan of the supermarket varies in sizes of conduit and wire due to great variations in lengths of panel homeruns—some of which are over 250-ft long. On each lighting circuit that exceeds 200 ft in length, four No. 8 wires are used for the 3-phase, 4-wire homerun and only three 4-tube, 8-ft luminaires are connected to each phase of the circuit. On circuits between 150 and 200 ft, four luminaires are connected on each No. 8 phase of the homerun. On still shorter circuits, three luminaires are connected on each No. 10 phase of a homerun. And for luminaires still closer to the panel, four luminaires are connected on each No. 10 phase of a homerun. This use of limited loading and larger wire as circuit length increases provided effective limitation of voltage drop to the most distant outlet. A maximum drop of only 1% was maintained throughout the entire area (264-ft long by 160 ft).


Conduit connector assembly
Ballast assembly
Wireway channel cover
Wireway channel
A
Lamps (four)
Tee member installed by acoustical contractor
Lamp holder box assembly
Gooseneck (part of lamp holder box assembly)
Wireway channel detail

WIRING DETAILS of the lighting system show the various elements, including the octagon box to which the homerun conduit couples to supply the branch circuit wires to the fixture. Because the ballast is not mounted in the wireway channel, the channel is approved for through-wiring using 60 C conductors (type TW or R) instead of type AVA or type SB. In the supermarket, each group of luminaires (three or four units, as indicated on the accompanying plan) is wired in the continuous wiring channel.



PARKING LOT LIGHTING is supplied by 480/277-volt circuits in underground Transite from the meter room in the main building. Layout of the shopping center buildings is shown here. Only a small section of the parking lot and surrounding property is shown.

ments for the sales area by about 7½ tons and in turn decreased the number of heat pumps from ten units to nine units. This was not only an initial savings but offers considerable operational savings as well.

Studies are being made of temperatures of the ballasts in the areas above suspended ceilings of this type. There are indications that these temperatures may be well below those experienced by the ballasts confined within conventional luminaires. The manufacturer of the integral luminaire-ceiling system was requested to make a 4-tube lampholder unit built to specifications. The design was based on modern illuminating engineering data and called for a 5-in. minimum spacing between fluorescent tubes instead of the 2¾-in. of the conventional unit. Calculations indicated that by changing the fixture design from the standard tube spacing to the special design tube spacing, a bonus of 14 to 16% more light was obtained. This bonus of light output for the same installational and operational costs was obtained at an additional cost of less than $500.00. To obtain the same amount of additional light through the use of additional lamp socket holder units of the standard production variety would have amounted to over $4,500.

The initial footcandle readings for the marketing area were just above the 150 mark which should give a maintained installation of well over 125 footcandles. This is within 2% of the calculated values for maintained illumination levels. The special 4-tube lampholders on 12-foot centers were used, and the white, acoustical suspended ceiling was at a 12-ft mounting height.

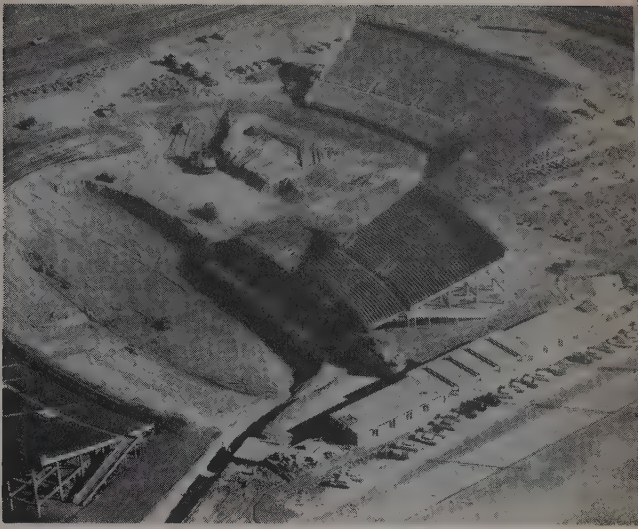
A master control panel in the manager's stand electrically locks the scales, cash registers, and additional equipment at each of 14 checkout stands. The decorative post-lighting units at each stand serve as supplementary lighting as well as indication of an available cashier. These circuits are also controlled from the master switching center in the manager's stand.

Special decorative building lighting, to highlight the stand and masonry details of the structure, was incorporated in original fixtures designed in cooperation with the architect and sign manufac-

(Continued on page 187)

Lighting A Stadium

A uniform level of 100 footcandles on the playing field is achieved by a new floodlighting installation at Texas Tech's athletic stadium, installed by Monger Electric Company, Fort Worth, Texas.



EXTENSIVE PROGRAM for expansion of stadium included moving of concrete stands back 225 ft to a new location, excavation of the center portion of stadium to a depth of 30 ft and installation of a high capacity floodlighting system.

LIFTING OPERATION for each 159-ft floodlight pole is made by power crane. Each tower is raised as a single unit, requiring only the bolting in place and electrical feed connections at the base.

WHAT does a university do when it has outgrown a perfectly good floodlighted stadium? Simple, it just moves 6,000 tons of concrete stands back a couple of hundred feet, excavates nearly a quarter-million cubic yards of dirt for a sunken bowl effect and installs more stands and a new floodlighting system.

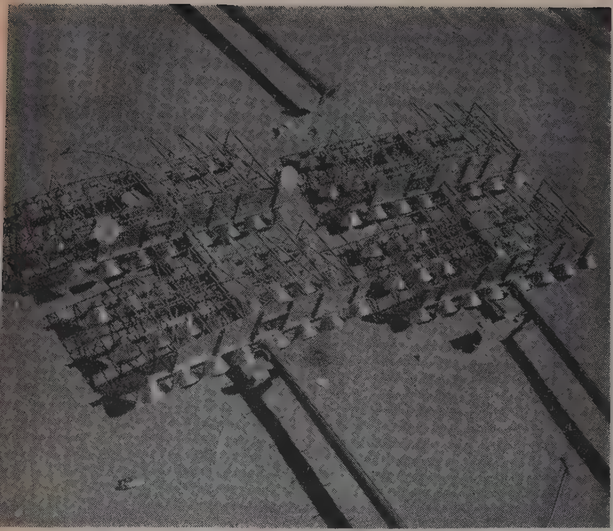
This gigantic task was all done during one "off season" at Texas Tech's Jones Stadium at Lubbock, Texas, and was completed in time for the Red Raider's first full season of participation in the Southwest Conference last year. Because many conference games are played at night, key consideration was given to the development of the floodlighting program and a total of 576 incandescent floodlights were used to illuminate the field to a maintained level of over 100 footcandles.

Actually, Texas Tech never intended at first to perform the miracle move. When they were notified that they had been admitted to the conference, university officials considered building a new stadium with 40,000 seating capacity. A detailed cost analysis, however, showed that it would be more economical to enlarge the existing stadium, which seated 27,000, than to build a new stadium. Thus, it was decided to undertake a giant engineering task that had never been attempted before. It went off without a hitch.

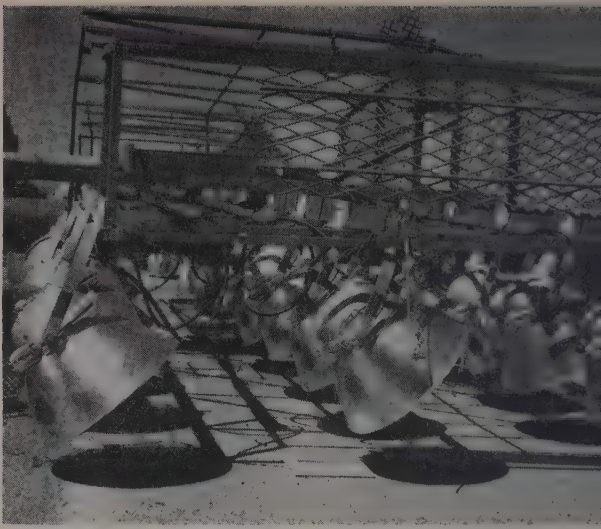
The big move consisted mainly of moving seven sections of steel reinforced concrete stands on the eastern side of the field back 225 feet. To accomplish this, 4,500 ft of railroad rail was brought in for the project. Six lengths of rail were placed under each section to be moved. Rails were leveled and supported by 6 by 6 pine blocks. The weight of the stands was then transferred to special dollies which moved on a series of 26-pound steel rollers. Existing column supports were removed, and the stand section was winched along the rails to the new foundations.

At the same time, crews were excavating 230,000 cubic yards of dirt from the central portion of the stadium to make a new playing field 30 ft below ground level. Three sides of this excavation were carefully sloped for the installation of additional concrete stands. On the fourth side, the south end of the stadium, new athletic offices and dressing rooms were constructed.

A new floodlighting system was designed to illuminate the rebuilt stadium. The old stadium had been



COMPLETE ASSEMBLY of pole-top array—including floodlights, wiring, aiming, catwalks, lighting panels and supply feeder—was made with poles lying on the ground. Poles were raised into position when the top assembly was ready.



CONSTRUCTION DETAILS of pole-top assembly shows: lightweight aluminum floodlight units with tempered glass covers to protect bulb and reflector from weather and dirt; latches on each unit for swinging back the head for relamping, without altering the preaimed position of the unit; weather-resistant cord from each unit looping through hole cover on underside of conduit fittings to splice to branch circuit wires from panelboard.

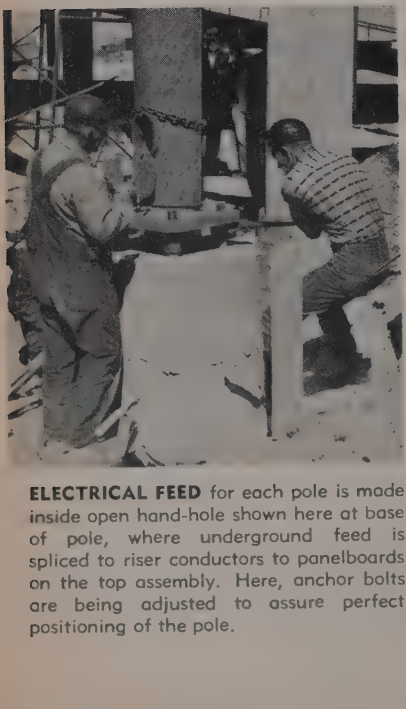
lighted from six poles, each holding 24 floodlights. Because of the increased distance between the football field and the farthest row of spectators in the reconstructed stadium, the level of illumination on the new field had to be increased to a maintained level of well over 100 footcandles to provide maximum viewer enjoyment in all parts of the stadium.

To obtain this level, a total of 576 floodlights were installed on 12 welded steel poles. These units were equipped with 1500-watt, G-48 incandescent lamps, which are operated at 10% above rated voltage to obtain a 35% increase in light output.

The total load for the floodlights is 970.2 kw. Primary power is brought in at 4,160 volts and it is stepped down to 208 volts, with wiring to the floodlights at 120 volts.

The 159-ft steel poles were first placed on the ground; and the complete floodlight, catwalk and distribution assembly was installed on each pole before it was raised to the elevated position. The completely assembled poles were then raised by power crane, secured by anchor bolts to pre-poured footings, and the wiring from the floodlights was spliced to underground feeder lines. The height of the pole plus the 30-ft excavations gave a total height of 189 ft from field level to top of pole.

The aiming of the floodlights was then checked according to spotting charts prepared to provide uniform lighting coverage of the field. Each pole holds 48 floodlights, and poles are held together in pairs by spacer units at each of the six tower locations. Lighting results met design objectives.



ELECTRICAL FEED for each pole is made inside open hand-hole shown here at base of pole, where underground feed is spliced to riser conductors to panelboards on the top assembly. Here, anchor bolts are being adjusted to assure perfect positioning of the pole.

FINISHED INSTALLATION shows three towers on one side of the field, with new press box in rear and new concrete stands in foreground.

ELECTROLUMINESCENT PANELS, covering 521 sq ft, make up the large, flat surfaces of this giant luminaire in the lobby of the Rice Hotel, Houston, Texas.

Electroluminescence in Hotel Lobby

One of the most extensive hotel modernization programs ever undertaken, has just been completed by the Rice Hotel, Houston, Texas. The event is especially significant because it marks the first large scale use of electroluminescence, man's newest light source, for decorative illumination. The dramatic installation is part of a $5 million redecorating program undertaken by the 48-year old hotel.

Electroluminescence units are actually flat panels of glass, metal or plastic with an electrical conductive film. They are coated with a special phosphor. When electricity is applied, the panels glow. There are no filaments, tubes or vapors and practically no heat is produced. Not only are the units virtually fail-proof, but the current drain is almost negligible.

The hotel has installed a unique ceiling of electroluminescent light in the new lobby. The installation in the hotel covers 521 sq ft and consists of 128 individual light panels. The panels are blue in color to simulate the natural color of the sky. The dramatic ceiling is a perfect ellipse 31 ft long.

Kliegl Brothers Lighting of New York engineered and manufactured the special 20-ft by 27-ft oval-shaped fixture which uses the Rayescent panels. In addition, Kliegl supplied a unique dimming circuit which automatically raises the light panels to full brightness as daylight approaches and lowers the light output during the night-time hours.

Since the light panels, which have been specially designed for the installation, operate at 600 volts (60 cycles) the power kit was provided by the manufacturer to operate the unusual ceiling.

8-Fc Street Lighting

A canopy of mercury vapor lighting has converted downtown Redwood City's Broadway into one of California's brightest shopping streets.

This San Francisco Bay area city's street lighting has been boosted to 8 footcandles, 30 times brighter than the old incandescent lighting which it has replaced, by 49 modern mercury vapor luminaires mounted on arching davit poles.

Redwood City, which owns and maintains its street lighting equipment, selected 1000-watt mercury luminaires for the relighting of Broadway, its downtown business street. Installed by Central Electric Company, Redwood City electrical contractors, the units are mounted 30 ft above the street, and extend out 6 ft from the sidewalk curb line where the poles are located. The davit poles are located opposite each other, and spaced 100 ft apart. The luminaires are wired on two series circuits, with alternate units on the same circuit. One circuit is operated until midnight, while the other circuit operates all night.

This $40,000 installation was paid for jointly by the city and by the property owners on Broadway—the city 25%, and the property owners 75%.

Choice of the new lighting system was a study in cooperation between city officials and the merchants. The city's desire for more efficient light on the street led to an exhaustive technical analysis of lighting requirements and equipment.

To supplement the engineering review, the citizen committee re-

BRILLIANT canopy of light frames Broadway, downtown business street in Redwood City, Calif., with a uniform level of 8 footcandles. Type M-1000 GE mercury vapor luminaires, equipped with 1000-watt color-improved mercury lamps, are mounted 30 ft above the roadway, at 100-ft intervals on each side of the street, on gracefully curving davit poles.

PLM Type ACSJ-15
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5 to 23kv cable splices to make?

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Splicing armored cable . . . non-metallic sheathed cable . . . lead-covered cable? There's a PLM Splicing Kit to simplify the job and insure correctly designed splices with a minimum of time and effort! Each PLM Splice Kit contains all materials needed for making one correctly-designed splice (including aluminum or galvanized steel casing), together with clear, step-by-step instructions for making it. Need for ordering or stocking many separate items is eliminated.

PLM Splicing Kits, complete with casings, are also supplied for making 3 and 4-way splices with armored cable. PLM kits and fittings are fully listed and described in PLM 52-page catalog 301. Write on letterhead for your copy.

PLM Products, Inc
TERMINATING AND SPLICING ACCESSORIES
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sponsible for the project visited various Bay area cities, to inspect and appraise their street lighting installations. The group took along cloth swatches from a local clothing store, compared the color qualities under different types of lighting, and came up with their own selection—color-improved mercury lighting, using Type M-1000 General Electric luminaires.

Broadway's merchants are enthusiastic about the bright new lights, now that the installation has been completed. "It gives a warm, cheery look to the area," comments one, "and tends to make the whole town want to look modern." Shopowners also point to the lighting's contribution to better after-dark business during holiday seasons and during long winter nights.

Redwood City's police chief, William Faulstich, describes Broadway at night as "just like daytime." He points out the benefits of the new lighting in terms of crime and traffic accident prevention. "It's a deterrent to crime, especially after midnight," he says. "You can see into doorways now from a motorcycle, instead of having to get off and investigate on foot. And pedestrians are safer. It used to be very dangerous to cross the street after dark, especially on a rainy night. Now pedestrians are plainly visible under such conditions."

The new whiteway was designed by Ed Coleman, supervisor of Equipment and Buildings, and F. V. Moynahan, associate engineer, under the direction of City Engineer Glenn M. Jain.

Use Flat-Bed Trailers As Mobile Work Centers

Mobility of tools and material handling equipment is a key to efficient electrical installation practice. Within the limits of multi-story building construction, central field shop and assembly areas work well —particularly where deck or floor layouts permit mass-production, repetitive operations.

Large open areas present a different installation problem. Here, it frequently is more practicable and efficient to have mobile work centers follow installation progress. Backtracking for material and tool items is reduced substantially.

Electrical contractor use of mobile work centers was observed at two outdoor installation proj-

very day, more electrical contractors are discovering just how easy it is to ork with aluminum conductors. For one thing, aluminum weighs much less r equivalent current-carrying capacity. 1000 feet of 1/0 AWG aluminum ype RHW weighs 147 pounds less than its copper equivalent. It's easier handle at the installation site. It's easier to pull. ■ And, of course, it osts less than copper. Look at the table: it gives you an idea of the vings you can make in wire costs when you switch to aluminum. ■ Get e full story on aluminum building wire from your Rome Cable Distributor. r write to Rome Cable Division of Alcoa, Department 722 , Rome, N. Y.

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COPPER			ALUMINUM			SAVINGS	
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2	7	174.00	1/0	19	122.00	52.00	30%
4/0	19	531.00	300 MCM	19	367.00	164.00	30%
500 MCM	37	1210.00	750 MCM	61	854.00	356.00	30%

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Cast of high-strength malleable, these new RIDGID Conduit Benders have an exceptionally smooth, typically RIDGID quality finish you'll like on sight. Look in the extra deep sockets, and you'll see the threads down at the bottom. Elimination of strain on threads of pipe handle reduces breakage.

RIDGID Thin-Wall Conduit Benders Available in 3 Sizes

B-1677 Bends ½″ Thin-Wall Conduit to 4″ Inside Radius
B-1678 Bends ¾″ Thin-Wall and ½″ Heavy-Wall Conduit to 5″ Inside Radius
B-1679 Bends 1″ Thin-Wall and ¾″ Heavy-Wall Conduit to 6½″ Inside Radius

Exceptionally smooth side-walls hug conduit snugly . . . minimize distortion. Benders form conduit to meet National Electric Code Standards. Steadying foot pressure is easily applied on non-slip step plate. Easy-to-see arrows give accurate guide for back-to-back and stub bends.

RIDGID Hickey-Type, Heavy-Wall Conduit Benders

B-1711 Bends ½″ and ¾″ Heavy-Wall Conduit
B-1712 Bends ¾″, 1″ and 1¼″ Heavy-Wall Conduit

Here's a rugged bender for heavy-wall conduit. Deep notch in lifting hook protects threaded ends. Face of bender has hardened teeth for safe, long wearing, non-slip grip.

Call your Distributor today. For your convenience, he maintains a complete stock of RIDGID Work-Saver Pipe Tools and parts!

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The Ridge Tool Company, Elyria, Ohio, U.S.A.

BACK OF TRAILER has facilities for cutting, reaming and making up duct joints. Long plywood crib (at rear) holds couplings, spacers and other accessories.

PORTABLE GENERATOR on trailer at airport project provides electric power for conduit threader and assortment of electric hand tools. Note conduit bender in background.

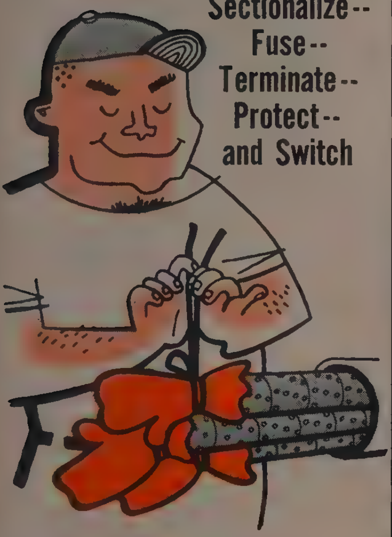
ects. One was a new high-voltage underground duct distribution system at Purdue University in Lafayette, Ind. The other involved conventional conduit work for jet aircraft taxi strips and terminal aprons at Chicago's O'Hare International Airport.

For the Purdue project, Hatfield Electric Co. used several moderate size (approximately 12 ft by 7 ft) flat-bed highway trailers to move fiber duct, accessories and installation tools. A typical trailer contained a palleted bundle (46 lengths) of 5-in. duct; a long plywood crib (24 in. high, 18 in. wide) partitioned for duct spacers, couplings and other accessories; a pipe vise and work space at the back of the trailer for cutting, tapering, reaming and assembly of offsets and short duct sections. In some cases, the pallet frames formed racks for lightweight metal ladders used by mechanics to get in and out of deep duct trenches.

A similar trailer was used as a mobile conduit work center by J.

Oil-Fuse Cutouts

Can--
Sectionalize--
Fuse--
Terminate--
Protect--
and Switch



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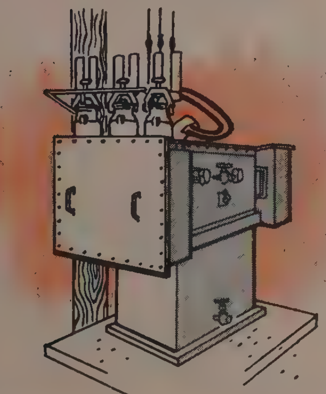

In-- Vaults--Manholes--
Under Water--Overhead--
Moist Atmospheres--
Hazardous Locations--Salt Air--
or No Vaults At All

And Are-- Safe--Reliable--
Pressure Tight--Submersible--
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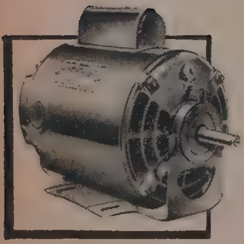

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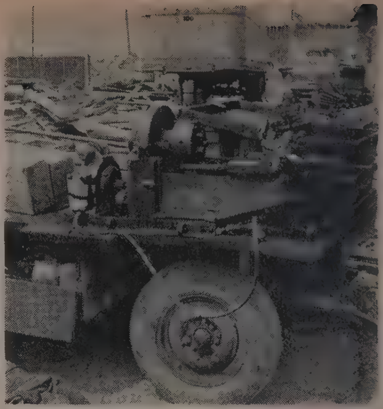

POWER THREADER on trailer speeds conduit assembly work; is powered by portable generator (hidden by tool box cover). Mobile work center can be moved quickly to follow work progress.

Livingston & Co., joint-venture electrical contractor at Chicago's O'Hare Field expansion project. Operating as a joint-venture group on the project are Divane Brothers Electric Co.; Fischbach, Moore & Morrissey, Inc.; Hyre Electric Co.; and J. Livingston & Co.

In addition to a pipe vise, conduit bender and storage facilities for hand tools and conduit accessories, the Livingston trailer featured a gasoline-driven generator unit to power a trailer-mounted conduit threading machine and necessary 115-volt and 220-volt electric tools.

In both cases, the trailers could be moved to follow work progress or be quickly spotted at pre-determined locations to bring the work centers closer to point of installation. The net result was a minimum of back-tracking and a highly efficient field operation.

NEW CODE RULES are discussed by J. A. Wishart, building inspector, Withersfield, Conn. (L), and L. H. Johnson supervisor of installation and inspection, Hartford Electric Light and Power Co., at the 1961 IAEI Eastern Section meeting in Philadelphia.

ADVANCE In-warranty Labor Insurance compensates for normal ballast replacement labor cost

ADVANCE IN-WARRANTY
ILI
ADVANCE TRANSFORMER CO.
LABOR INSURANCE

what is ILI?

The ADVANCE TRANSFORMER CO. ILI (In-warranty Labor Insurance) Program is designed to reimburse the Electrical Contractor for normal labor costs incurred in replacing ADVANCE In-warranty High Power Factor Fluorescent Lamp Ballasts.

ILI permits the Contractor to guarantee both labor and ballasts in fluorescent lighting installations. It gives fast and more efficient service for lighting equipment manufacturers' products if an ADVANCE Ballast becomes inoperative within the two-year warranty period.

Here's how ILI works . . . .

1 The Electrical Contractor contacts his ADVANCE Representative when he experiences an ADVANCE in-warranty ballast failure. The ADVANCE Representative will qualify the job and issue an (In-warranty Labor Insurance) ILI number.

2 The Electrical Contractor takes the inoperative ballast together with the (In-warranty Labor Insurance) ILI number to any ADVANCE Service-Stocking Distributor. The Distributor supplies the Contractor with new ADVANCE Ballasts at no charge and gives the Electrical Contractor an ILI form.

3 The Contractor completes and sends the form to ADVANCE TRANSFORMER CO., 2950 N. Western Avenue, Chicago 18, Ill. He receives a non-negotiable check for replacement labor cost which will be redeemable in merchandise at any ADVANCE Service-Stocking Distributor.

WRITE FOR COMPLETE ILI BROCHURE

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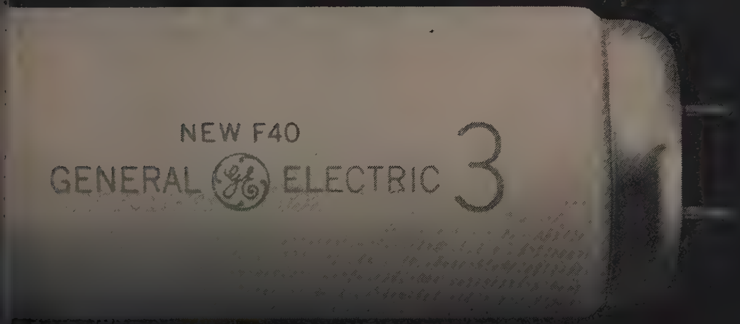
WORLD'S LARGEST EXCLUSIVE MANUFACTURER OF FLUORESCENT LAMP BALLASTS
TRANSFORMER CO.
2950 NO. WESTERN AVE. CHICAGO 18, ILL. U.S.A.

Last year, General Electric introduced a new standard in 40-watt fluorescent lamps. More light: 7% more at no extra cost. Other lamps are trying to match this new standard, but the gap is not closed—you still get more when you buy General Electric.

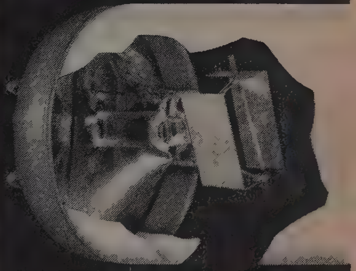
That's not all. Conflicting statements may serve to make a decision difficult. If you have an older lighting system, you can get more life from lamps other than the New F4 General Electric has always had the lamp for thes installations: the F40/54. This lamp provides light ou put and life equal to—or better than—any other lam in this service.

Most people prefer to get the most light for their dolla however. For this purpose, the F40 is the best buy

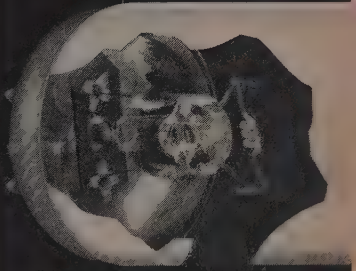
catch up with the G-E standard?



PROOF YOU CAN SEE INSIDE ANY NEW F40 LAMP SHOWING WHY WATTAGE IS SAVED, CONVERTED TO MORE LIGHT



Wattage Miser Electrode



Old-Style Electrode

In old-style lamps, wattage wasted in the cathode is burned up. In the General Electric F40, special plates (anodes) eliminate the loss, then it is converted into useful light—all at no cost to you. This is what General Electric means by proof you can see. No other 40-watt fluorescent can give you the extra lighting power that you get from the G-E F40.

more lumens per dollar, measurably, than any other lamp on the market.

Before you accept any claims about light or life, demand to see proof. Your General Electric distributor will be glad to show you exactly why you get more when you buy General Electric. You can start profiting from this kind of proved leadership right now—by seeing that the lamps your company specifies are General Electric lamps. General Electric Company, Large Lamp Department C-208, Nela Park, Cleveland 12, Ohio.

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WING-NUT
CONNECTOR

Now three sizes

The new small WING-NUT model 451 handles combinations as small as two No. 18 wires. Now there is a WING-NUT for every size wire splice you normally make.

The only built-in wrench

Unique wing grip. Twist WING-NUT on quickly, easily, by hand without **any tools.** Easy to splice even largest stiff wires. Simply screw on, then snip off wings for compact spaces. No awkward, slippery, soft-plastic grip.

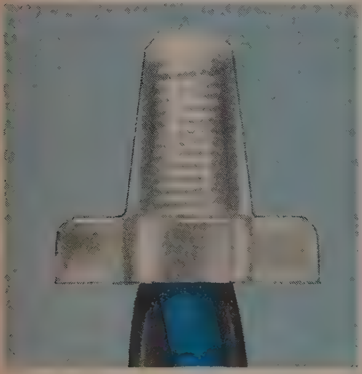
The only visible splice

Your splice is always visible—no take-apart for inspection. WING-NUT is the only screw-on connector that lets you **see** the splice is **right** . . . through the semi-transparent Nylon insulating shell.

Joins heaviest circuits

Only WING-NUT has a Nylon shell with such a wide deep skirt to splice even the largest wires. Easily slips over two No. 8 and a No. 6. Easiest connector for thick Type RW, too. No flash-over. Three sizes to handle all needs.

3 SIZES - *covering all types of branch circuit wiring and fixture hanging*



WING-NUTS shown actual size.

Can't cold-flow with Nylon shell

Unbreakable, high-dielectric Nylon shell is tough and stable . . . won't cold-flow and short-out by stretching thin under pressure or strain. WING-NUT is the **only** screw-on branch circuit connector giving you the many benefits of the strongest and safest shell . . . genuine Nylon.

The most U.L. branch circuit combinations

All sizes of WING-NUT are Underwriters' Laboratories approved as pressure cable connectors for general use (600V) in branch circuit and fixture wiring. Only WING-NUTS are approved for 816 combinations of solid and/or stranded wire.

WING-NUT is the easiest, fastest, safest branch circuit wire connector you can use. Its inner tension-spring coil actually threads and crushes wires in a shake-proof "PYTHON GRIP!" You just can't make a better splice . . . especially on the new large, hard wires.

The helping
hand on
every wiring job

Sold through America's Leading Distributors • In Canada: Irving Smith, Ltd., Montreal

IDEAL INDUSTRIES, Inc.
1041-B Park Avenue • Sycamore, Illinois

CONVEYOR LOOP encircles final assembly station. As transformers go around loop, they get nameplates, identification stencils, oil, tilt-test, air evacuation, and final mechanical check. Center rack with oil hose and nozzle hides tilt-test rig.

SPUR LINE at other side of conveyor loop brings units to electrical test station. Here assembled cores and windings are getting turn-ratio test. In addition, completed units get induced and full-voltage tests and check for radio interference.

Roller Conveyors Cut Material Handling

Effective use of roller conveyors is an important factor in the efficient operation of the distribution transformer repair and manufacturing division of Southwest Electric Company, Oklahoma City electrical apparatus service firm. From the time a unit comes into the shop until ready for shipment, it and its component parts ride a path of rollers past related work stations where various repair and assembly operations are carried out. The system provides a smooth work flow while minimizing material handling problems.

The assembly conveyor line ends in a closed-loop which completely encircles the final work station. Here bushings, cable terminals, nameplates and identification stencils are added. Assembled units are filled with oil; tilt-tested to detect leaks; have excess air evacuated and go on to where final electrical tests are made.

Audio Amplifier Detects Small Motor Noise

Some motor noise, particularly in very small motors, is inaudible to the human ear and hence difficult to detect. Where noise level is critical to motor application and operation, as in GCA aircraft control systems, reliable methods must be developed to detect and remedy such noise. Special equipment is needed for such tests.

At Evans Electric Motor Repair Company in Oklahoma City, audio amplification is used to detect noise in motors sent in for repair by the local Federal Aviation Agency. To handle this type of work, Evans management has set up a separate test room and added an electronics technician to its staff of regular employees.

Technician Donald Guinn applies the phonograph principle to his test procedure. With the motor operating on a sponge-rubber pad, he pinpoints the noise with a sensitive probe which passes it through an amplifier and speaker to put it in the audible range. The probe, a conventional turntable pickup cartridge with a metal stylus, is placed at various points on the motor frame. As the probe is moved from spot to spot, the pitch (frequency) of the amplified speaker noise varies. With past experience and a trained ear, the technician is able to determine from the pitch if the noise is caused by a bad bearing, dragging armature or other condition.

AMMETER CLAMPED around 10-turn coil on amplifier chassis permits reading motor running currents below meter range. Speaker is at left. Motor rests on sponge-rubber "isolation" pad.

WE Pledge . . .

Margin for SAFETY

"Margin for SAFETY"

is the *extra* protection that Shawmut builds into its products for your benefit. You get *extra* value when you need it most. It's the *extra* that makes Shawmut circuit protection devices stand up when the showdown comes. It isn't a boast or an empty claim. It's quality above and beyond the standards set for the industry — built right into the product.

"Margin for SAFETY"

begins with integrity — integrity of character . . . integrity of engineering . . . integrity of materials . . . integrity of craftsmen. It comes from trying to give more for the money — not less. It doesn't come from skimping, misrepresentation or deception. It comes from experience, know-how and leadership.

"Margin for SAFETY"

is part of all Shawmut circuit protection devices. It is your guarantee that you are getting more than you pay for. It is your assurance that Shawmut products are fairly represented. They not only meet industry standards, they exceed them. It means that all Shawmut products are engineered to the application for which they are intended.

When you want **"Margin for SAFETY"** look for the Diamond "S" and the Shawmut name on the fusible products which you buy. Only Shawmut can give you this "Margin for Safety."

S®

THE **CHASE-SHAWMUT** CO.
374 MERRIMAC STREET • NEWBURYPORT, MASSACHUSETTS
Subsidiary of I-T-E CIRCUIT BREAKER CO

AUDIO AMPLIFIER is used to diagnose noise symptoms in very small motors at Evans Electric Motor Repair Co. test room. Motor under test is a 1/50 hp, 1800 rpm, 225-volt, single-phase unit.

A clamp-on ammeter with a 0-5-amp range normally is used to check motor current. For readings below the scale range, the ammeter is clamped around a 10-turn coil in the motor circuit.

Multi-Voltage Console Gives Test Flexibility

Mobility of test equipment facilitates diagnostic and final check tests on integral horsepower motors at Kirby Risk Electric Motors Inc. service shop in Lafayette, Ind. Instead of taking motors to a stationary test panel, a variable voltage console is rolled up to the motor for an on-the-spot check.

The console takes up about 5 sq ft of floor space; can be rolled anywhere in the shop and plugged into

MULTI-VOLTAGE CONSOLE is rolled over to a large motor for routine diagnostic check. Mechanic checks motor current with clamp-on ammeter. Drawer at base holds variety of cords.

Symbol of Security

The small red box on the wall is the Gamewell "Century" non-code station — a symbol of the same dependable protection, *in* buildings, that the familiar Gamewell street box brings to most of our cities.

The attractive, functional *Century* box is just one element in the Gamewell "Flexalarm" line of interior systems. The Flexalarm *building-block* concept allows freedom in designing systems for maximum protection in every type of building. And this flexibility is backed by factory trained sales representatives who offer you the benefit of Gamewell's specialized experience in fire alarm engineering.

You can depend on the name of Gamewell. Fire protection has been our profession for over 100 years.

The Gamewell Flexalarm catalog illustrates typical fire alarm installations that afford maximum protection at minimum cost. For your copy, write THE GAMEWELL COMPANY, 1315 Chestnut Street, Newton Upper Falls 64, Mass. A Subsidiary of E. W. Bliss Co.

BLISS
Gamewell®
FIRST...WHEN SECONDS COUNT

ADAPTABILITY

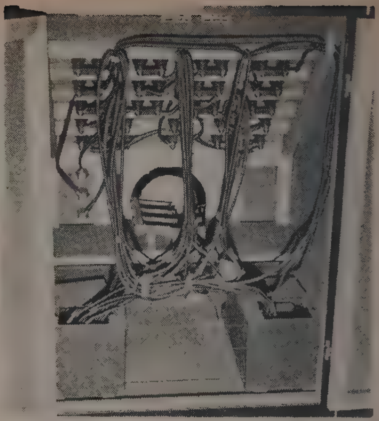
The "SCOTCH" Brand Electrical Tape No. 33 used to wrap splices on these television station power cables, insulates completely and snugly. Adaptable, it conforms neatly to both small and large size conductors, is easy to work with in tight, confined areas. Seals splices permanently for only a few cents. When tape costs so little, can you afford less than the best?

BALANCED FORMULA IS THE SECRET: Whatever the task, you can depend on "SCOTCH" Brand Electrical Tape No. 33. Its perfect balance of physical properties provides the ultimate in holding, protecting and insulating all in one wrap. Strong, stretchy, it has the perfect "feel" to get jobs done faster, done right. Tough vinyl backing shrugs off moisture, sunlight, heat, cold and other adverse conditions. Pressure-sensitive adhesive adheres instantly, holds permanently, without creeping or end-lifting. Low power-factor provides excellent insulation . . . high electric strength, wet or dry. For every job you can put your confidence in "SCOTCH" Brand Electrical Tape No. 33.

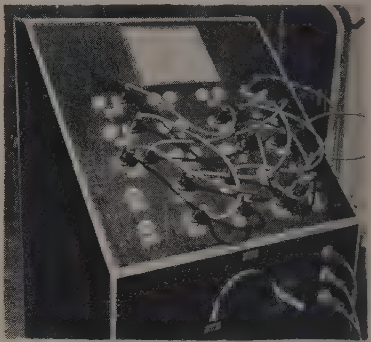
FIRST and still the best

3M Electrical Products Division
MINNESOTA MINING & MANUFACTURING CO.

"SCOTCH" is a Registered Trademark of 3M Co., St. Paul 6, Minn.



CABINET INTERIOR showing 10-kva Scott-connected transformers, double-throw switch (center) and connections to console jacks.



CONSOLE PANEL has rows of numbered jacks. Directory above gives jumper connections to secure desired voltage and phase characteristics. Incoming line jacks are to right of transfer switch in "high" (or 440-volt) position.

a 220-volt, 3-phase outlet. Constructed of a wood frame with fiberboard enclosing panels, it is light in weight and easy to maneuver into position. The cabinet is 24 in. deep, 30½ in. wide and 51½ in. high; has an inclined jack-panel for external circuit connections; has an externally-operated double throw switch with "low," "off," "high" positions.

Available test voltages are 30, 115, 230 and 440, 2- and 3-phase. Those 115 volts and below are on the "low" position of the transfer switch; 230 volts and above are on the "high" position. Two 10-kva, single-phase, Scott-connected transformers inside the console provide the required test voltage and phase requirements through the external jack-plug connections.

Thirty-four jacks, with identifying numbers, are mounted in five rows on the console panel. A framed directory card on the panel shows which jacks must be externally connected to secure the phase and voltage characteristics of the motor.

9,000 HOURS

is now the rated average life of Champion standard and Slimline fluorescent lamps.

No other brand offers this 20% bonus of light in Slimline models.

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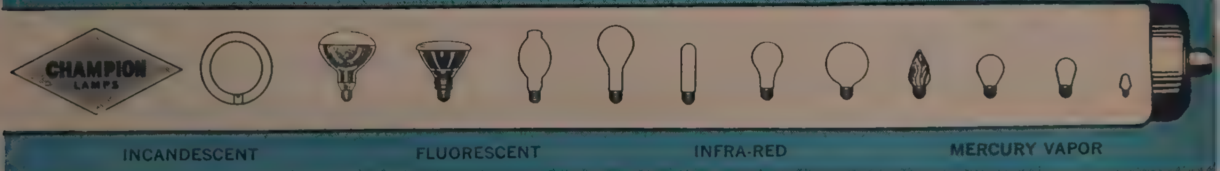
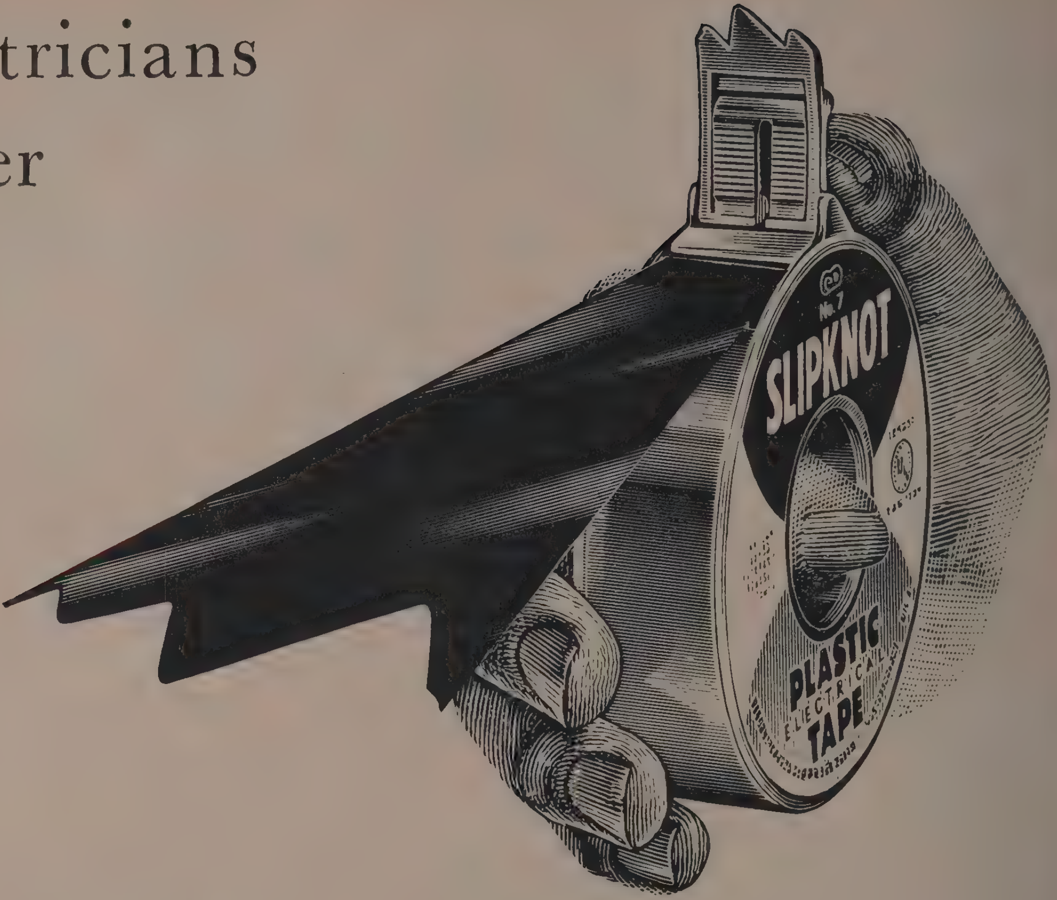
Lynnway, Lynn, Mass. LYnn 3-2000



Experienced Electricians Prefer *this tape*



SLIPKNOT

Whether you're splicing transmission lines or residential outlets, every splice you make must be *final*, *safe* and *permanent*. You can only be sure with the *best* — and it costs no more. #7 SLIPKNOT PLASTIC ELECTRICAL TAPE is the choice of electricians who *know*, because it *handles easily*, *conforms readily*, and *snugs* and *stays down.*

With adhesive *permanently* fused to vinyl base, with *controlled tension* for proper stretch without dangerous thinning — with *unvarying quality* in roll after perfect roll — no wonder #7 SLIPKNOT PLASTIC ELECTRICAL TAPE is the *specified* plastic tape.

Discover why SLIPKNOT is found in all the best splices. On us. Just tell us your distributor's name, on your letterhead, and we'll send you a sample roll.

SOLD ONLY THRU RECOGNIZED DISTRIBUTORS

FLIP 'N CUT®, a Slipknot exclusive, speeds the job and saves you money. It's FREE with each 30' · 44' · 66' roll!

FL-7

PLYMOUTH RUBBER COMPANY, INC.

QUALITY SINCE 1896 CANTON, MASSACHUSETTS

Control Unit (1)

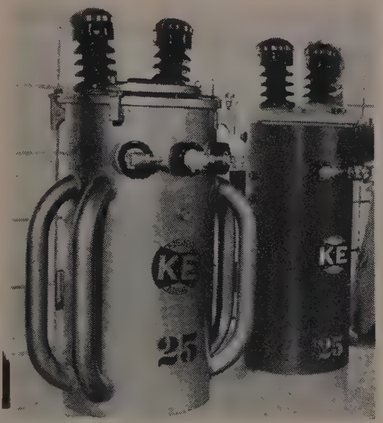
A new "break-glass" oiltight control unit is now available. To operate the unit, break a glass plate covering a red metal disc in the lock ring. The unit comes in a kit that includes a 5-in. long, cast iron hammer with attached chain, and five extra glass plates to install as replacements. Unit is available with either one or two contact blocks. Each block contains one normally open and one normally closed double-break contact. Pilot duty ratings are: ac 6 amps, 110 volts to 1.2 amps, 550 volts; dc 0.4 amps, 115 volts to 0.1 amp, 550 volts.

Allen-Bradley Co., 136 West Greenfield Ave., Milwaukee 4, Wis.

Luminaire (2)

A new Series 6820 Quartzoval "500" luminaire designed for the 500-watt quartz iodine lamp. Unit is available with a variety of reflector and lens combinations to produce wide, medium, or narrow beam patterns. In addition to plain lens and reflector combinations which produce three basic beam patterns, the Quartzoval "500" is available with a special prismatic lens. When used with the narrow beam reflector, this lens produces a trapezoidal beam pattern which falls in a rectangular pattern when directed at an angle of 70° to the vertical normal to the surface being lighted. Other features include a choice of clamp-type or hinge-type over, and 2-in. slip fitter or ¾-in. emale fitter mounting arrangement. Bulletin 100-43-9 is available.

Revere Electric Mfg. Co., 7420 Lehigh Ave., Chicago 48, Ill.



Transformer (3)

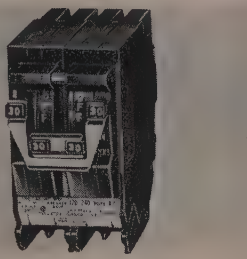
A new line of 65C rise transformers have been introduced. Transformers are shorter in height than previous designs. Cooling tubes have been eliminated through 50 kva. Transformer can be loaded up to 120% of nameplate rating without exceeding total losses of previous designs and up to 138% without exceeding previous voltage drop levels. New designs take full advantage of the 65C rise winding temperature, longer life and greater durability of high temperature insulation. Several mechanical changes including a new cover clamping arrangement have also been made. The new designs will be offered in all popular pole-type ratings through 500 kva.

Kuhlman Electric Co., Birmingham, Mich.

Enclosures (4)

A new series of small NEMA Type 1 enclosures to house electrical or electronic controls. Ten stock sizes range from 8 by 6 by 4 in. to 14 by 12 by 6 in. Optional control panels may be installed on weldnuts in back of boxes. Boxes are made of 16 gauge steel and finished in grey enamel inside and out over a phosphatized surface. Mounting panels are of 14 gauge steel with a baked white enamel finish.

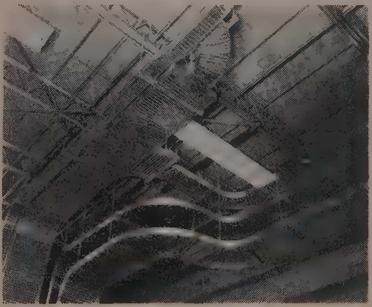
Hoffman Engineering Corp., Anoka, Minn.



Circuit Breaker (5)

A new double 2-pole "Twin" circuit breaker increases panel capacity. Rated 30 amps, 120/240 volts ac, this breaker, Cat. No. TRP4130, permits installation of two 2-pole circuits in the space of one conventional size breaker. Features include permanent factory-installed stainless steel handle ties, UL Class NI listing, recessed spring-reinforced bus receptacles and molded wire strip gage at all load end terminals.

General Electric Co., Circuit Protective Devices Dept., Plainville, Conn.

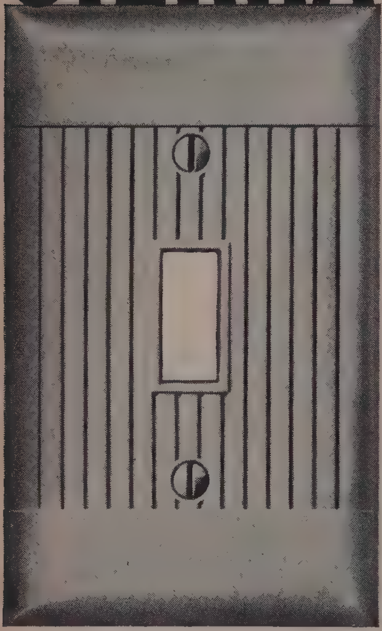


Cable Baskets (6)

A new line of cable baskets, called the Ventrib TM cable support system, is primarily designed for electrical cables. The slotted design permits easy banding or clamping of cable. Made in standard lengths of 12 ft and standard widths of 6, 12, 18 and 24 in. from corrugated, vented 22 gage steel bottoms, Ventrib sections are resistance welded to 16 gage roll formed side stringer channels. Positive basket splicing is completed by Qiklok TM coupling. The complete line of Ventrib basket fittings consists of straight sections, 30, 45, 60 and 90 degree horizontal and vertical bends, crosses, tees and reducers. Standard radius of all fittings is 12 in.

Husky Products Inc., Div. of Burndy Corp., Cincinnati, Ohio

SIERRA



THE WORLD'S MOST COMPLETE LINE OF WALL PLATES

Your one source for the greatest variety of openings, styles, colors and materials.

Sierra Plastic Plates meet all codes and are listed by UL

SIERRA ELECTRIC CORPORATION
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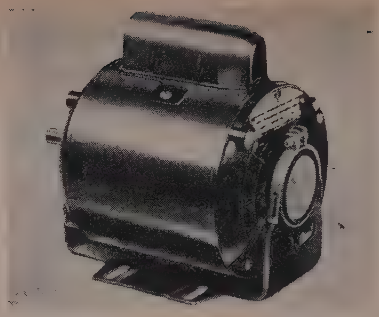
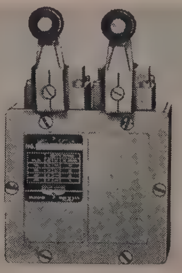
Write for more information and catalog



Motors (7)

A complete line of NEMA "48" motors has been introduced. The line consists of blower motors, general purpose capacitor-start motors and special purpose motors for specific applications. Features are: shafts are treated for corrosion resistance; large wiring compartment and built-in threaded conduit hole; rigid and resilient mounts are available; motors are designed for all-angle operation; $\frac{5}{8}$-in. shaft diameter. A new type switch features built-in point gap control, wiping action of points and special molded contact pad. Oil fed to the bearing surfaces is filtered by felt wicking.

Emerson Electric Mfg. Co., 8100 *Florissant Ave., St. Louis* 36, *Mo.*



Switches (8)

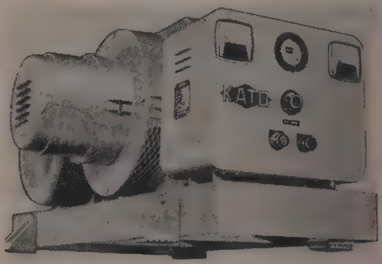
Recent additions to this line of Type L oil tight limit switches have made available a duplex limit switch which is actually a two-in-one package. Essentially two surface mounted limit switches in one enclosure, each switch is operated independently of the other. All rotary levers for the spring return switches may be utilized on the standard duplex switch set up; and the rotary lever operating types with spring return are standard features. Ideally suited for operation when two Type L limit switches are to be mounted side by side, this switch may also act as a safety device in critical applications by having the operating dog actuate both switches in order to provide added insurance.

Cutler-Hammer, 315 *North* 12*th St., Milwaukee* 1, *Wis.*

Ballast (9)

A new line of two-lamp indoor constant wattage ballasts for 96T12 or 72T12 800 ma rapid start lamps are now available. This line has a standardized mounting dimension of $13\frac{3}{4}$ by 2. Catalog 670-205 is listed by UL and has been CBM approved.

Sola Electric Co., Elk Grove Village, Ill.



M-G Set (10)

A new motor-generator set changes 50-cycle, 220/440-volt current to 60 cycles, 120/208-volts. Voltage regulation is plus or minus 2% to full load. The revolving field type generator is rated at 5 kva, .8 power factor, 120/208-volt, 3-phase, 4-wire, 60-cycle, 4-pole, 1800 rpm; complete with direct connected, separate rotating exciter. Motor is 7.5 hp synchronous induction type, 220/440 volts, 3-phase, 50-cycle, 4-pole, 1500 rpm. Generator and motor are mounted on a common steel base, belt-driven. Control panel includes voltmeter, ammeter, frequency meter, automatic voltage regulator, magnetic across-the-line starter and start-stop pushbutton station.

Kato Engineering Co., Mankato, Minn.

Paging Device (11)

A new miniature paging device, designated the Pagefone, measures $1\frac{1}{4}$ by $2\frac{1}{2}$ by 4 in. and will fit into any shirt pocket. Operating indoors or out, the unit does not require the conventional telescoping antenna; features a squelch control, automatic noise limiter and plug-in-crystals. Utilizing any of the 23 citizens band channels, the Pagefone can be used with any 27 mc base station or walkie-talkie. It is for use in applications where personnel are required to move over a large area such as in restaurants, banks, hospitals, guided tours, hotels, conventions, factories, warehouses, etc.

U. S. Communications Corp., 6439 *Sunset Blvd., Hollywood* 28, *Calif.*

AT LAST!

A REAL HE-MAN'S CONNECTOR FOR BRANCH CIRCUIT AND FIXTURE WIRING . . . UP TO 1000 VOLTS!

Hi TRADE MARK REG.

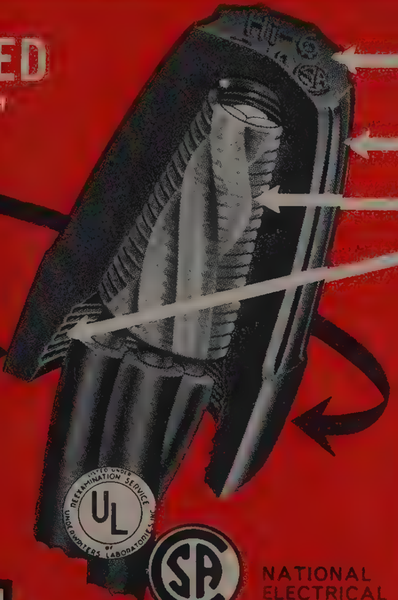
BAKELITE • SCREW-ON

WIRE CONNECTORS

NEW . . . IMPROVED "Hi-QUALITY"

BUILT-IN

"BAND-OF-STRENGTH"



Thick, strong wall and skirt prevent breakage . . . even under severe pressure.

UL, CSA and wire sizes shown on end of connector

Coarse knurling for solid, safe grip

Steel insert, copper coated

Wide, deep-threaded throat

NATIONAL
ELECTRICAL
CODE

ACTUAL SIZE . . .

WIRE YOUR NEXT HOUSE ON US!

"BONUS BAG" . . . FREE WITH THE PURCHASE OF 300 "Hi" WIRE CONNECTORS (one size or assorted).

Hi
BONUS BAG
OF NEW "HI" WIRE CONNECTORS
FREE...
WITH THE PURCHASE OF 300 "HI" WIRE CONNECTORS
WIRE YOUR NEXT HOUSE ON US!

. . . ENOUGH "Hi" CONNECTORS TO WIRE THE AVERAGE SIZE HOUSE.

Try the Bonus Bag. If you are not completely satisfied, return unopened cartons for refund.

Here's the toughest, strongest connector made! The *band-of-strength* design permits you to exert full pressure while screwing connector onto wire.

STRONG—DEPENDABLE—FAILPROOF

"Hi" Connectors are precision made on the very finest equipment. Continuous inspection throughout manufacture positively assures uniformity. No loose springs—no duds!

GET YOUR FREE "BONUS BAG"!

Take this ad to your wholesaler today! (Limited Time Offer)

U.L. approved as pressure cable connectors for general use . . . for branch circuit and fixture wiring up to 600 volts (1000 volts when enclosed in fixture or sign). Three sizes safely handle hundreds of combinations of Nos. 18-10 solid and/or stranded wires.

USE "Hi-QUALITY" CONNECTORS ON YOUR NEXT JOB!

free samples on request . . . write to

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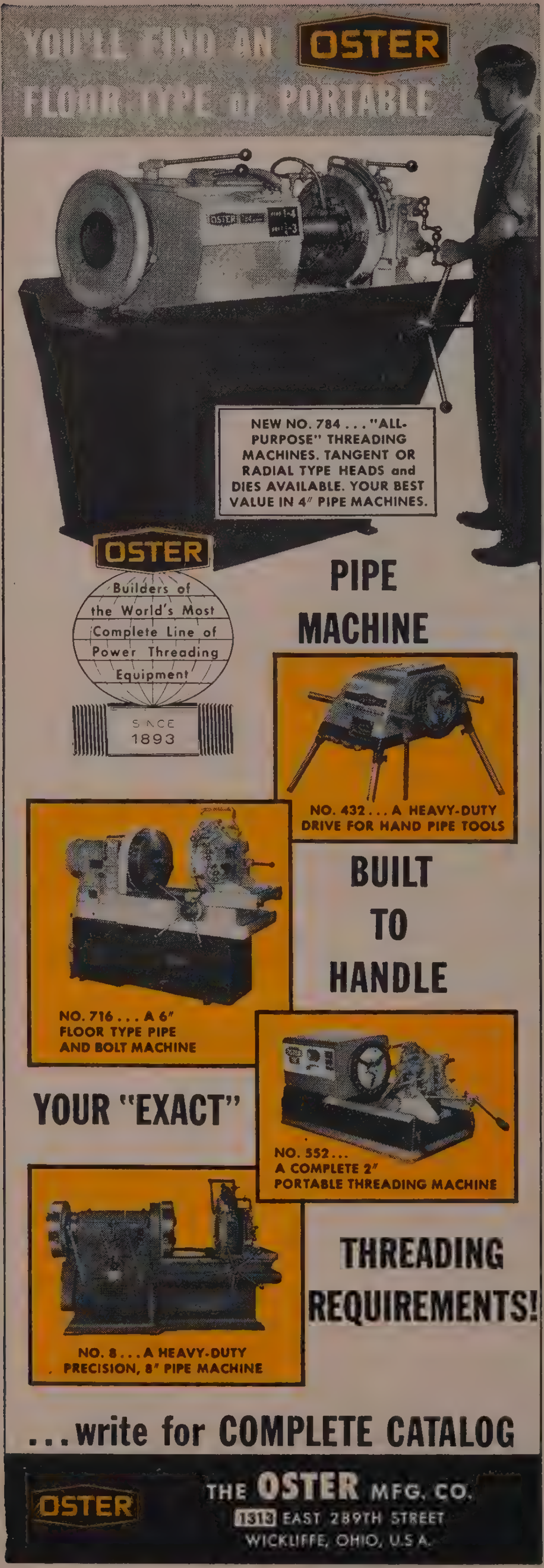
HOLUB INDUSTRIES, INC.
442 ELM STREET • SYCAMORE, ILLINOIS



YOU'LL FIND AN OSTER FLOOR TYPE or PORTABLE

NEW NO. 784 . . . "ALL-PURPOSE" THREADING MACHINES. TANGENT OR RADIAL TYPE HEADS and DIES AVAILABLE. YOUR BEST VALUE IN 4″ PIPE MACHINES.

OSTER
Builders of the World's Most Complete Line of Power Threading Equipment
SINCE 1893

PIPE MACHINE

NO. 432 . . . A HEAVY-DUTY DRIVE FOR HAND PIPE TOOLS

BUILT TO HANDLE

NO. 716 . . . A 6″ FLOOR TYPE PIPE AND BOLT MACHINE

YOUR "EXACT"

NO. 552 . . . A COMPLETE 2″ PORTABLE THREADING MACHINE

THREADING REQUIREMENTS!

NO. 8 . . . A HEAVY-DUTY PRECISION, 8″ PIPE MACHINE

. . . write for COMPLETE CATALOG

OSTER
THE OSTER MFG. CO.
1313 EAST 289TH STREET
WICKLIFFE, OHIO, U.S.A.

Service Equipment (12)

A 100-amp main lugs only (split bus) device has been added to this line of expandable fusible service equipment. It has two 60-amp "Renu-Fuse" units; one for the lights which controls eight plug fuse circuits, and the other for the range, etc. When additional circuits are required, the following can be added: one or two, 30- or 60-amp "Renu-Fuse" units which may be used for water heater, dryer, air conditioner, etc.; plus two to four, 15- to 30-amp plug fuse circuits for appliance circuits, etc. The expandable switch is rated 100 amps, 3-wire S/N, 120-240 volts ac. Plug fuse circuits are equipped with Type "S" adapters. Surface door trim and dead front are new hook-on type and the 100-amp line terminals are suitable for aluminum or copper conductors.

Wadsworth Electric Mfg. Co., Inc., Covington, Ky.

Insulating Cover (13)

A flexible polyethylene insulating cover for service entrance sleeves has been introduced. The cover fits all ⅝-in. diameter compression sleeves up to 2 in. long. It is made of a specially formulated virgin polyethylene with a dielectric strength of 350 volts/mil. Designed to encircle the sleeve, the cover snaps into place. Vent ports prevent accumulation of rain and condensation. Cover is impervious to extremes of heat and cold. It withstands cable temperatures up to 250°F.

Jasper Blackburn Corp., 1525 *Woodson Rd., St. Louis 14, Mo.*

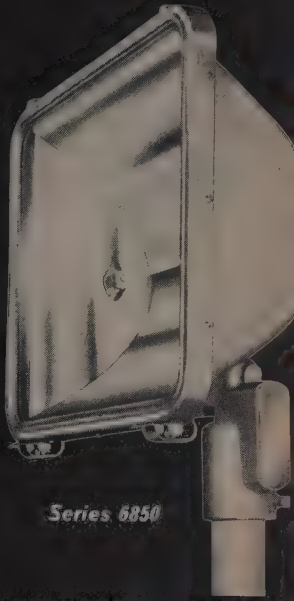
Series 6820

Revere Quartzoval "500" for 500-watt quartz-iodine lamps provides choice of wide, medium or narrow beam with plain lens. The unit also provides a trapezoidal beam with a special prismatic lens and narrow beam reflector. This beam produces a rectangular light pattern when directed at a 70° angle to the vertical that is normal to the surface being lighted. Available in all conventional mounting arrangements and either clamp-type or hinge-type cover.

Series 6803

No.6808-1NF

Revere Pole-Top Area-Light for 500-watt quartz-iodine lamps is offered with two luminaire units back-to-back, or with one functional and one "dummy" unit back-to-back. Slip fitter is for 2" pipe. Also available as single luminaire unit with flush back for wall mounting. All styles available only with special prismatic lens and narrow beam reflector to deliver a rectangular light pattern.



Series 6850

Revere Quartzoval "1500" for 150
watt quartz-iodine lamps provid
choice of wide, medium or narr
beam. Available for cross arm
flat base mounting or with 2" s
fitter. Unit for cross arm mounti
has fabricated steel mounting brac
et and locking type protractor. Wi
beam reflector produces 120° x 6
beam spread; medium beam refle
tor produces 105°x30° beam sprea
narrow beam reflector produces 9
x 6° beam spread.

New Revere Quartzoval luminaires efficiently use quartz-iodine lamps in wide range of applications

This new family of Revere luminaires is designed to make full use of all the light engineered into the 500- and 1500-watt T3 quartz-iodine lamps. The variety of Revere luminaires, lenses, mounting styles and beam patterns offered means you can select a combination that's ideally suited to virtually any quartz-iodine lamp application.

These Revere luminaires are designed to capitalize on all the advantages of this new lamp — compact size and light weight; high, maintained lumen output; economy; and long lamp life. Each of the Revere luminaires above provides precise horizontal beam control with sharp vertical cut-off to utilize the lamp efficiently, and each offers the additional advantages of easy, trouble-free installation and servicing. For complete information write for Bulletin 100-43-9.

Revere OUTDOOR LIGHTING EQUIPMENT

Revere Electric Mfg. Co. • 7420 Lehigh Avenue • Chicago 48, Illinois
(In Suburban Niles) Long Distance Phone: Area Code 312 Niles 7-6060
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RVR-1-207

BOSS ELECTRICAL ENCLOSURES

BOSS

When you need consistent high quality and dependable, fast delivery, call for BOSS electrical enclosures.

BOSS J.I.C. and NEMA wiring boxes, trough and wireway provide protection against oil, water, dust or dirt. All BOSS boxes and wireway are phosphatized before baked enamel finish is applied.

"Specials" are quoted promptly, fabricated accurately to your specifications and serviced for quick shipment.

Write for catalog which shows the complete line of BOSS products carried in stock for immediate shipment. Sold through leading electrical distributors everywhere.

THE HUENEFELD CO. ENGINEERED PRODUCTS DIVISION
2705 SPRING GROVE AVE. CINCINNATI 25, OHIO

Transformer (14)

An improved 3-phase distribution transformer uses two single-phase transformers connected in T and assembled in one tank. In the 225- to 500-kva range, both no-load and total losses are lower. In the 500-kva size, the no-load loss of the T-connected transformer is 1350 watts, compared to 1800 watts for the previous design; total loss is 6900 watts for the new design, 7720 watts for the previous unit. Impedance is also lower—3.6% as compared to 4.9% for the 500-kva unit. The T connection also permits flexibility in physical design. Core and coils can be placed one on top of the other and fitted in a round tank design; or core and coils can be placed side by side for a pad-mounted design.

Westinghouse Electric Corp., Box 2278, Pittsburgh 30, Pa.

Fittings (15)

New set screw rigid conduit couplings and connectors in all sizes from $\frac{1}{2}$ in. to 4 in. can be installed using only a small combination box and open-end wrench or plier. The $\frac{3}{8}$-in. hex head screws tighten easily. The set screw is firmly seated in the wall of the conduit for positive ground. Both connectors and couplings are concrete tight and are listed by UL.

Midwest Electric Mfg. Co., 1639 W. Walnut St., Chicago 12, Ill.

Electric Furnaces (16)

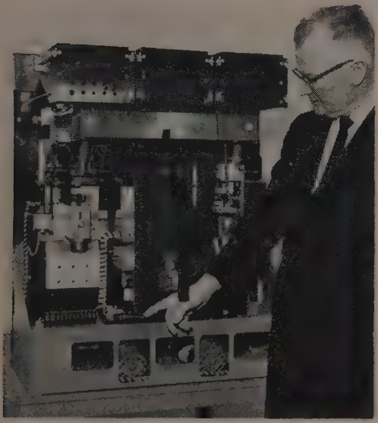
A new line of electric furnaces employ belt-driven, two-speed blowers with adjustable pulleys and are available in ratings from 34,100 to 68,300 Btu's. The unitized cabinets are insulated around the heater compartment and may be installed in horizontal, upflow or counterflow positions. Heating elements of the nicrome wire type are turned on in sequence by means of a cam-operated, five-stage switch with stages approximately two minutes apart. Furnaces are 20 in. square and slightly more than 42 in. high, excluding 1-in. duct flanges at either end. All units are factory wired for 240-volt operation.

Air Conditioning Div. of American-Standard, 40 West 40th St., New York 18, N. Y.

Combination Couplings (17)

Two items have been added to this line of combination couplings. No. 659 is used for coupling ¾ in. EMT to ¾ in. flexible steel conduit (Greenfield). No. 660 is used for coupling ¾ in. flexible steel conduit to ¾ in. rigid or any fitting having a male thread. Other combination couplings ranging in sizes from ½ in. to 1 in. are available to accommodate transition from EMT to rigid.

Allen-Stevens Conduit Fittings Corp., 33-53 62d St., Woodside, N. Y.



Circuit Breaker (18)

A new fused low-voltage circuit breaker, the RF4, has a continuous rating of 4000 amps, with an arc chute interrupting rating of 100 ka, and a fuse interrupting rating of 200 ka. It can be stacked two high in a 90-in. cubicle. A specially designed transformer in breaker gives user a choice of any control voltage between 120 and 600 volts without changing the auxiliary wiring. The RF4 is designed with overload relays that are able to discriminate between faults that can be interrupted by either the arc chutes or the fuses.

Mears Controls, Inc., 13725 S. W. Millikan Way, Beaverton, Ore.

Gives you a new sense of mastery over digging time and costs!

New DAVIS T-78
Trencher and Dozer with D-100 Backhoe

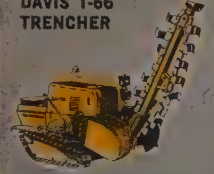
This revolutionary, all-purpose rig handles all of your trenching, digging, and ditching jobs from 4″ to 36″ wide to 8′ 4″ deep. It adds the finishing touch by backfilling and leveling up to the final grade. The new 18-h. p. Davis T-78 trenches smooth and clean 18″ wide, 26″ deep to 4″/6″ wide, 78″ deep and at varying widths and depths in between. The power-packed Davis D-100 Backhoe, designed as quick-detachable attachment for the T-78, takes over on bell holes, laterals, septic tanks, and other excavations to 8′ 4″ deep, or for trenching in extremely rocky areas which no trencher can touch. Performance and quality are built in. Efficiency, compactness to work in areas inaccessible to conventional equipment, unusual versatility and digging ability, and low investment will make you "rigged for profit"! Special Davis Hustler Trailers are available for transporting.

THE T-78 has ground-gripping (track) traction, high flotation (3.6 lbs. psi ground pressure), and is only 37″ wide. Spoil can be delivered to left or right. Trenches up to 840 feet per hour.

THE D-100 BACKHOE has in access of 10,000 lbs. pryout pressure and a full 180° operating arc at constant speed. it's compact, and power-packed with no compromise in quality. **Also available for most utility tractors.**

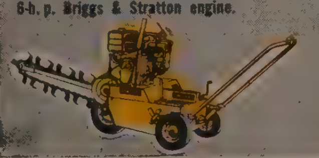
Other Profit-Rigged Davis Trenchers

DAVIS T-66 TRENCHER



Digs where others can't because of its compact design, ground-gripping traction and high flotation. Trenches from 16″ wide to 24″ deep, to 4″ wide, 66″ deep.

DAVIS W-36 TRENCHER is a trenching man's trencher. Positively self-propelled by 6-speed winch drive. Digs from 3″ to 6″ wide, 36″ deep. Has 6-h. p. Briggs & Stratton engine.



SEND ME IN FOR COMPLETE FACTS

DAVIS MFG. INC.
1504 S. McLean Blvd. / Wichita 13, Kans.

Please send me free literature on the T-78 ☐ D-100 Backhoe ☐, T-66 Trencher ☐, W-36 Trencher ☐, Davis Hustler Trailers ☐.

NAME ______

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TOWN ______ STATE ______

T8-5-1161

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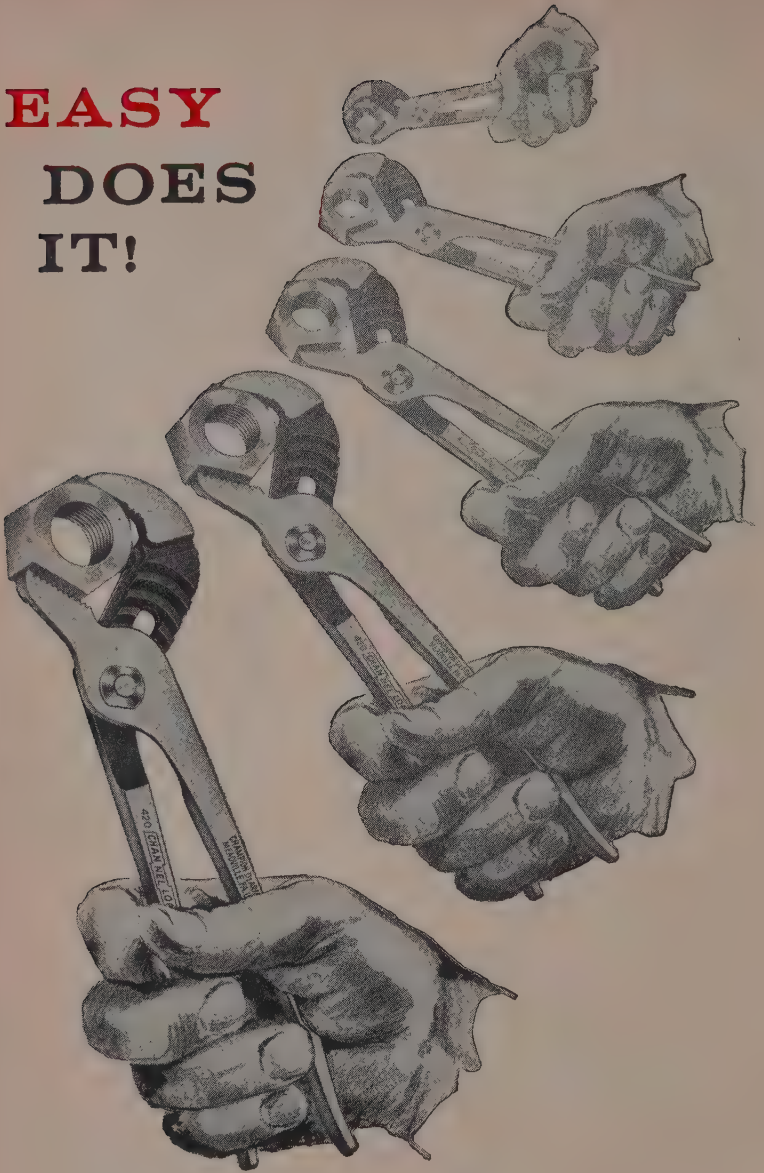
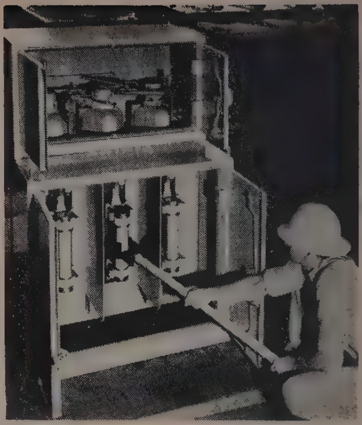


CHAN NEL LOCK®

You'll do every gripping job the easy way with a Channellock worksaver plier. Powerful parallel jaw grip . . . tremendous leverage . . . patented, smooth-working can't-slip adjustments. Your choice of five jaw capacities: ½, ⅞, 1½, 2 and 2¼ inches. *Be sure it's a* **genuine** *Channellock. Look for the trademark on the handle. Write for catalog showing complete line of pliers.* Made Only By Champion DeArment Tool Company, Meadville, Pennsylvania.



Switch **(19)**

New low-cost switching and high-current fault clearing equipment for primary voltage distribution systems. The F/O (fused-oil) interrupter switch is available in a compact cabinet and offers an economical means of load switching and overcurrent protection. Switches can be installed on floor, wall, or ceiling at factories, apartment and office buildings, hospitals, schools, etc. Units are suited for inside or outside installations in normal, explosive or contaminated areas. Oil cutouts and power fuses are connected in series. Switches are available at 5.1- to 15-kv. Dimensions are: 5 to 6 ft high, 3 to 4 ft wide and deep, and 800 to 1200 lbs.

General Electric Co., Schenectady 5, N. Y.

Ballasts **(20)**

A new line of two lamp indoor CW mercury lamp ballasts with independent lamp operation are now available. This line has a totally enclosed case with core and coil compounded. Lamp leads are available at both top and bottom. Primary leads are available only at top. Both wiring compartments are sealed off from the ballast compartment. Units are UL approved for the operation of two 400-watt lamps. Dimensions of units are $16\frac{1}{16}$ in. long by 7 in. wide by 11 in. high.

Sola Electric Co., Elk Grove Village, Ill.

Pipe Pusher **(21)**

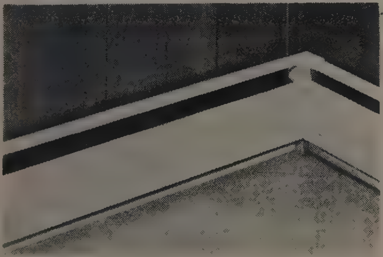
A new 179,000-lb thrust pipe pusher has been announced. It will grip pipe sizes up to 8 in. I.D. and can handle sizes down to 2 in. Model 2A60 has a 16-in. stroke and develops a continuous duty thrust of 179,000 lbs. It is normally furnished with one universal jaw and clevis assembly to handle pipe sizes from 2 to 4 in., as well as individual sized clamp-type jaws used for each pipe size over 4 in. and up to and including the 8-in.

Speed-Thru Co., 1300 *Walnut St., Denver* 4, *Colo.*

Garage Door Operator (22)

Self-contained automatic garage door operator, called the Genie Model "400," has been announced. It automatically unlocks and opens, or closes and locks any overhead garage door by remote control at the push of a button. Unit is UL listed and the TT-5 radio transmitter used to activate the Genie "400" is FCC approved. Both sectional and solid garage doors, up to 8 by 20 ft in size, can be handled. A ⅓-hp motor provides extra torque to permit handling of bulky doors. A safety device automatically stops door at slightest interference. The "Genie Switch" is available as an accessory for the Model "400" and consists of an automatic light timed to remain on after the garage door is closed.

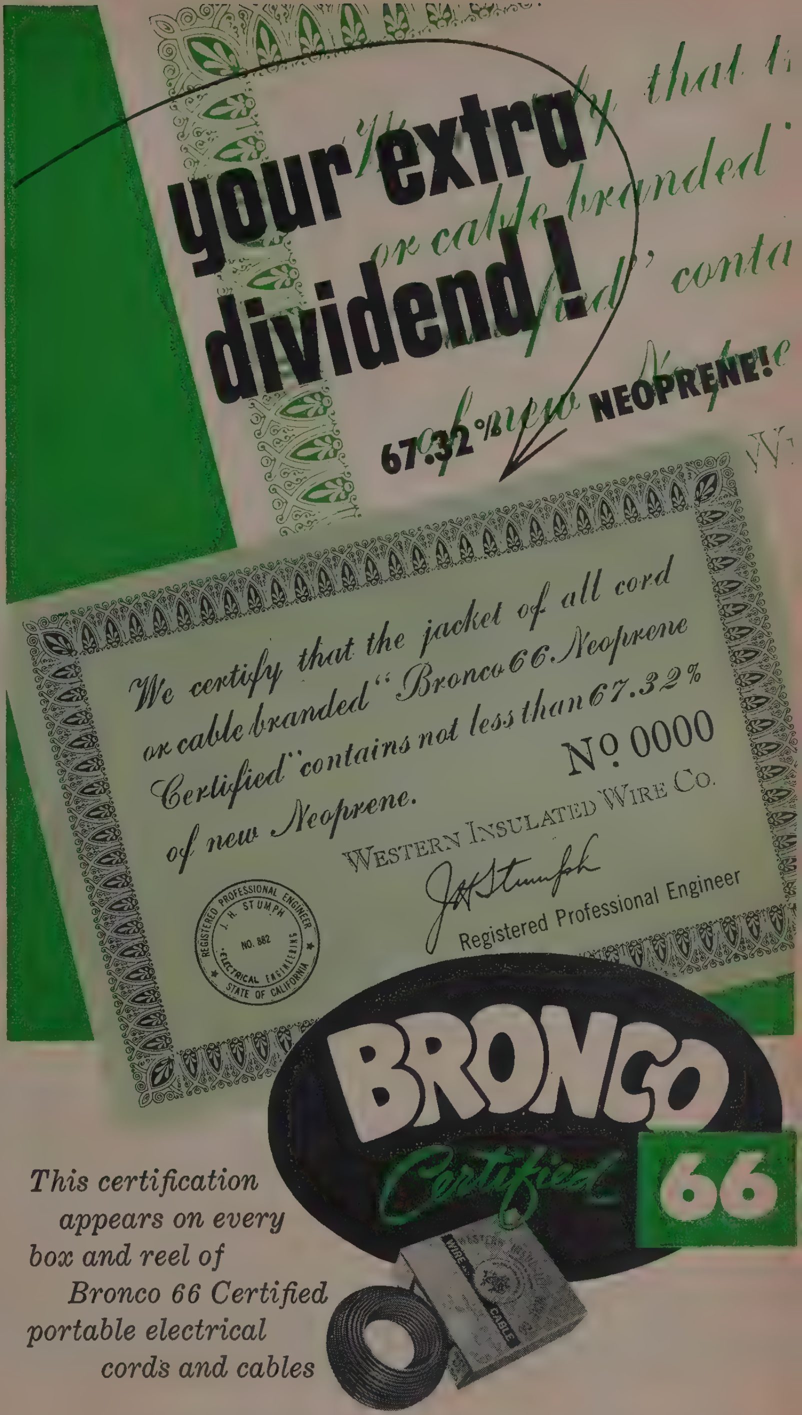
Alliance Manufacturing Co., Alliance, Ohio



Heaters (23)

A new line of baseboard heaters features knockouts at back and bottom and junction boxes at both ends. A series of predrilled holes allows direct connection to studding and front removes from the top for added convenience. Units are beige and can be painted to match any decorating scheme. A thermal overload protector provides automatic cut off if front of unit is blocked. Heaters are available in four lengths —3 ft 2 in., 4 ft, 6 in. and 8 ft and are rated for 750, 1000, 1500 and 2000 watts, 240 volts. Corner, receptacle and baseboard thermostat sections are available. Listed by UL.

Emerson Electric Co., 8100 *Florissant, St. Louis* 36, *Mo.*



We certify that the jacket of all cord or cable branded "Bronco 66 Neoprene Certified" contains not less than 67.32% of new Neoprene.

No. 0000

WESTERN INSULATED WIRE CO.

J H Stumph
Registered Professional Engineer

J. H. STUMPH
NO. 882

This certification appears on every box and reel of Bronco 66 Certified portable electrical cords and cables

Jackets with the highest Neoprene content in the industry! . . . your extra dividend in value, service life, flexibility, and safety. With 67.32% Neoprene you are assured all the oil resistance, ozone, flame, and abrasion resistance that can be provided by this advanced product of modern chemistry. When you specify Bronco 66 Certified, you know exactly what you are getting because a numbered, registered certification is affixed to each carton and reel. In addition, you will find "67.32% NEOPRENE" (along with complete identification) molded into the jacket so it won't rub off at exact two-foot intervals by a patented Bronco process. The Bronco catalog is growing. Is yours up to date? Write for your free copy.

Bronco Wires and Cables are sold through Electrical Wholesale Distributors and are manufactured by

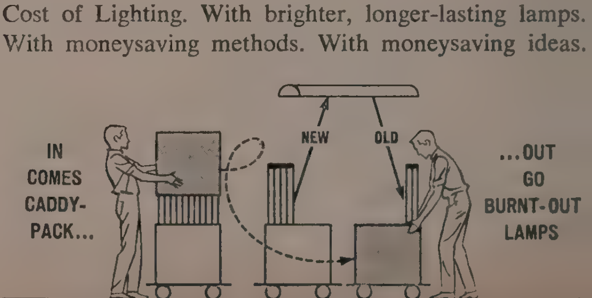
WESTERN INSULATED WIRE COMPANY
Los Angeles 58, California

New 60-lamp Caddy-Pack makes group relampin

Where are the big moneysaving ideas in lighting coming from today? Sylvania! Take Caddy-Pack, the latest:

60 new 9000-hour “Lifeline” fluorescents come packed safely, conveniently in one container. Yes, 9000 hours! And 3100 lumens! And standard price, too! Already you're ahead on costs. Zip open the Caddy-Pack. The top is specially designed to hold the old tubes you replace. No more fumbling with lots of containers . . . or loose tubes. Relamping becomes almost as simple as switching razor blades!

Caddy-Pack and Sylvania “Lifeline” tubes are typical of the many ways Sylvania gives you lowest TCL — Total Cost of Lighting. With brighter, longer-lasting lamps. With moneysaving methods. With moneysaving ideas.



aster...safer...more economical than ever!

And with an exclusive money-back Sylvania guarantee.* Any wonder Sylvania is a standout in every value analysis? For more facts, see your Sylvania representative now. Or write: Lighting Division, Sylvania Electric Products Inc., Dept. 15, 60 Boston St., Salem, Mass. In Canada: Sylvania Electric (Canada) Ltd., Montreal.

*"If at any time a Sylvania Fluorescent Lamp fails in your opinion to provide better performance than any other brand fluorescent lamps, on the basis of uniformity of performance, uniformity of appearance, maintained brightness and life, it may be returned to the supplier for full refund of purchase price."

SYLVANIA

SUBSIDIARY OF
GENERAL TELEPHONE & ELECTRONICS

GENERAL SYSTEM

In sewage-disposal plant, plastic bubble on corrosion-resistant cover plate permits switch sealed beneath it to be operated safely with wet hands. Moisture can't reach metal parts of switch.

Truck dock provides current to refrigerated vehicles via corrosion-resistant receptacles, lift-cover plates, "Twist-Lock"® cord caps, and non-metallic FS boxes.

Are corrosion-prone wiring devices corroding your maintenance budget?

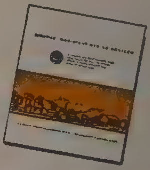
You can prevent repeated replacement of wiring devices in damp or chemically destructive atmospheres by installing our new corrosion-resistant "Chem Marine"® devices.

Made of materials exceptionally defiant to attack by brine, moisture, most acids, greases, and oils, these corrosion-resistant devices outlast the finest conventional equipment.

Indoors or out, their insulating and conductive elements remain unaffected by high or freezing temperatures, live steam, boiling water, and ultra-violet radiation.

Corrosion-resistant "Chem Marine"® devices are specification-grade products made only by Harvey Hubbell, Incorporated. The line includes receptacles, cord caps, cover plates, connector bodies, cap and body covers, power inlets, and non-metallic FS and junction boxes. Straight-blade, grounding, and "Twist-Lock"® configurations are available.

For complete information, write now for our 8-page, file-sized booklet: "Corrosion-Resistant Wiring Devices".



Corrosion resistant "Fiberglas" lift cover protects "Melamine" 3-wire receptacles from the corrosive effects of hot water cleaning, a daily hazard in poultry packing plants, dairies, bakeries and kitchens.

Fats, and moisture in meat packing have little effect on corrosion resistant devices. Left, porcelain "Twist-Lock" outlet is protected by a "Fiberglas" lift cover. Right, "Presswitch" is shielded by "Insulprene" plate.

®"Chem Marine" and "Twist-Lock" are registered trademarks of Harvey Hubbell, Incorporated.

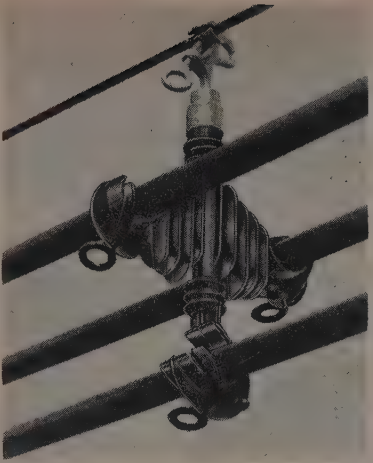
HARVEY HUBBELL INCORPORATED

Bridgeport 2, Connecticut

Corrosion-resistant wiring devices are used throughout a large Chicago bakery. Here, lights in refrigerator are controlled by press-type switches beneath corrosion-resistant, weatherproof switch-plates.

On industrial docks and barges, electrical systems require corrosion-resistant wiring devices. Here, weatherproof lift cover plate protects 3-wire grounding receptacle mounted in non-metallic F.S. Box. At base of piling, wiring is enclosed in non-metallic Junction Box.

IT PAYS TO HAVE HUBBELL GOOD CONNECTIONS
REG. U. S. PAT. OFF.



Cable Insulator (24)

A new LLD-7 spacer type aerial cable insulator has been announced. It is molded from a track resistant polyolefin, stabilized for outdoor weather. Insulator is a one piece assembly with a phase to phase spacing of 7 in. The insulator is attached to the messenger by means of a metallic, swivelled ball and socket, hot line clamp. A hot line tie will accommodate a range of conductor sizes, up to and including 1½ in. O.D. Insulator is recommended for the installation of cables having a voltage rating up to 35 kv.

Hendrix Wire and Cable Corp., P. O. Box 226, *Milford, N. H.*

Drives (25)

A complete line of adjustable speed dc drives with solid state regulators for flexibility has been announced. The StataFlex line, available in ratings from 1 through 200 horsepower, incorporates the latest developments in semi-conductor techniques and features a modularized packaging concept. Standard supply voltages for the new static drives are 240 volts ac for 230-volt dc motors, and 480 volts ac for 460-volt dc motors. Speed ranges up to 8 to 1 are provided by armature voltage control. The static drives are comprised of power unit, dc drive motor, and remote operator's control station.

Allis-Chalmers Manufacturing Co., Milwaukee 1, *Wis.*

Transducer (26)

A static saturable core transducer for measuring alternating current or voltage is called Teleductor. The output is 0- to 3-ma dc into any load up to 15,000 ohms. The dc output is directly proportional to the ac input over a wide range of load resistance and temperature. This is contrasted to a thermal-type transducer which provides an output proportional to the square of the input. It can be used as a telemeter transmitter in a supervisory control system or in any application where a metallic line wire circuit is available. Unit measures 4¼ by 3⅛ by 2¼ in.

Westinghouse Electric Corp., P. O. Box 2099, *Pittsburgh* 30, *Pa.*

Lightning Arresters (27)

The new Thorex Multirester has universally interchangeable terminals, accessories, and mounting devices. At each voltage rating there is only one basic arrester unit. Castings on both ends, with threaded holes, permit an interchangeable choice of terminal equipment. When insulation is required at the top or bottom, slip-over protectors are supplied. Threaded base castings permit use of a stud for direct mounting on the crossarm.

Ohio Brass Company, Mansfield, Ohio

Limit Stop (28)

New P50 crane safety limit stop supersedes the P1 device and offers a 20% increase in horsepower rating—up to 50 hp at 230 volts dc. Used to prevent crane hook overtravel when hoisting, this device disconnects the hoist motor from line and initiates dynamic braking. It features a fabricated steel enclosure and frame to provide all weather protection. It is available with either a straight lever or 90° right or left hand lever.

Cutler-Hammer, 315 *North* 12*th St., Milwaukee* 1, *Wis.*

Magnetic Clutch (29)

A new magnetic clutch, called Tormag drive, for ac, dc motors or gearmotors and for a wide range of industrial applications, has been introduced. Drives can be supplied mounted on motors from 1 to 30 hp for direct connections to the load. They can also be connected to the load through belts, chains or gearing. Available for coupled, chain, belt or geared service, the drive is easily coordinated with other drives of the same or different types into multimotor systems.

Westinghouse Electric Corp., P. O. Box 2099, *Pittsburgh* 30, *Pa.*

"How fast can it* be delivered?"

"It's available immediately...because your inventory is backed by Killark warehouse stocks in 18 cities!"

Killark distributors can usually deliver all electrical fittings and fixture requirements from inventory. If not, their customers' orders for most of the more than 7,500 items in the Killark line can be filled *at once* from a convenient Killark warehouse. There are eighteen of these dependable supply sources located throughout the United States and Canada, an important reason why the Killark distributor delivers on time.

* KILLARK XALB-6 EXPLOSION-PROOF PULLING ELBOW . . . with plus features that mean extra sales. Copper-free aluminum casting, permanently rust-proof and corrosion resistant, non-magnetic and non-sparking. Split design provides easy access to wiring; ribbed for greater strength. U.L. and C.S.A. approved. Carried in stock for fast delivery, a typical example of Killark's ability to supply all needs—large and small—for both hazardous and non-hazardous locations.

Write for the Killark catalogs.

Killark

ELECTRIC MANUFACTURING COMPANY
Vandeventer and Easton Ave. • St. Louis 13, Missouri
In Canada: Killark Electric of Canada, Ltd., 421 Islington Ave. South, Toronto 18, Ont.

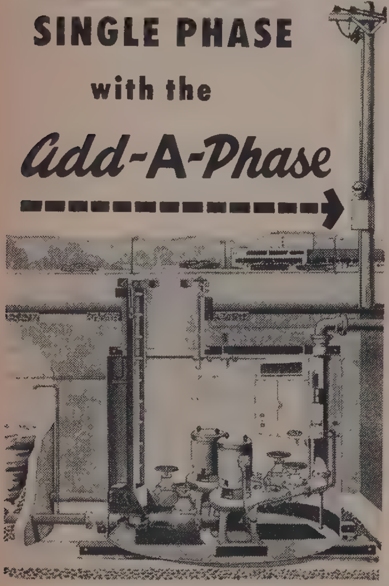
6101

* "MARKETS UNLIMITED" *

THREE PHASE SEWAGE PUMPING STATION...... OPERATES ON SINGLE PHASE

with the

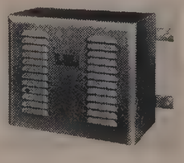
Add-A-Phase



SMITH & LOVELESS
Division — Union Tank Car Company
LENEXA, KANSAS

Artist's installation drawing of a Smith & Loveless factory-built duplex sewage pumping station. The Smith & Loveless pump station is designed for capacities from 100 GPM to 4,500 GPM per pump with two or more pumps per station.

Add-A-Phase POWER CONVERTER



- Balances for Any Load
- 100% Rated Load
- High Power Factor
- Balanced Currents
- No Loss of Work Power

Write for Complete Information

ADD-A-PHASE Dept. ECM-2
Div. System Analyzer Corp., Nokomis, Illinois

Gentlemen: Please send, without obligation, complete details on your ADD-A-PHASE Power Converter.

Name________ Title________

Company________

Address________

City________ Zone________

State________

SEE FOR YOURSELF . . . package includes many case histories of the success of the Add-A-Phase . . . years of trouble free use. IF YOU HAVE A SPECIFIC ELECTRIC POWER PROBLEM GIVE US THE DETAILS FOR RECOMMENDATION.

Catalogs, Bulletins and Engineering Data

(30) LUMINAIRES. Bulletin GEA-7242 describes shatter-resistant open-refractor luminaire for "private lighting" programs. General Electric Co.

(31) AIR CONDITIONING. Booklet AL-39 describes WhispAir central air conditioning and heating units (Types HB-18A, HB-18B and UB-18A). Westinghouse Air Conditioning Div.

(32) AUTOMATIC CONTROLS for heating, refrigeration and air conditioning are listed in new catalog. White-Rodgers Co.

(33) BATTERY CHARGERS. 4-page Bulletin 6.511-1 describes completely static, silicon-rectifier battery chargers for electric utility, railway communication and signalling, and industrial applications. Rectifier-Capacitor Div., Fansteel Metallurgical Corp.

(34) SWITCHES. Bulletin S-123 describes new electrically-operated switches designed to provide remote circuit opening and closing; and Bulletin S-134 describes a new ground fault protective device for use with the electrically operated switch. Pringle Electrical Mfg. Co.

(35) POWER TRANSFORMERS. GEA-7196 describes extra-high-voltage power transformers operating at 345, 500 and 700 kv. General Electric Co.

(36) WEATHERPROOF OUTLETS and switches, moisture-proof boxes, and other outdoor wiring accessories are described in new catalog. Bell Electric Co.

(37) ELECTRIC BASEBOARD HEATERS are illustrated in 4-page Brochure 6111. Anchor Mfg. Co.

(38) LUMINAIRES. Bulletin 700-15 contains complete information on the 2600 Series "Endoval" street lighting luminaire designed for use with 250- or 400-watt mercury lamps. Revere Electric Mfg. Co.

(39) BALLASTS. Two 4-page reprints (GER-1755 and 1757) entitled "A Thermally-Sensitive Protective System as an Added Value in Ballast Design" and "Fluorescent Ballasts and Noise Problems" includes a discussion of ballast protection methods and ballast failures. General Electric Co.

(40) DRILLING. "Successful Diamond Core Bit Drilling" summarizes many money saving ideas when using core drills and diamond core bits both in construction and plant maintenance work. Clipper Manufacturing Co.

(41) TRANSFORMERS. Catalog GEA-6604B gives scope, dimensions and basic concept of preferred design power transformers rated up to 230 kv, 400,000 kva. General Electric Co.

(42) BRAKES. 4-page Publication LJ-75 contains ratings, wheel data, and dimensions of the ac solenoid operated brakes. Cutler-Hammer Inc.

(43) GROUNDING SWITCH. Bulletin 1330 describes new spring-actuated, high speed ground switch featuring four-cycle closing time available in ratings from 15 through 230 kv, with 20,000 and 40,000 amps momentary. Greensburg Div., I-T-E Circuit Breaker Co.

(44) CONTROL PANEL with coded transmitter for automatic fire detection and alarm systems is described in Bulletin A-130.51. Notifier Corp.

(45) LOWERING MECHANISM which permits the lowering of specific luminaires to ground level for relamping or other maintenance is described in 6-page brochure. Pfaff & Kendall.

(46) GRAPHITE for rectifiers and power tubes is discussed in 6-page bulletin. Carbon Products Div., Speer Carbon Co.

(47) INKLESS RECORDER. 4-page brochure describes the new 620 Event recorder with Tempen, which writes without ink and can operate 50 days without a change in charts. Esterline Angus Instrument Co., Inc.

(48) DIELECTRIC TESTING. Bulletin 10-15-1 titled "High Potential Dielectric Testing" is a reprint of excerpts from the transcript of a technical seminar to clarify some of the confusion and disagreement regarding dielectric testing. Associated Research, Inc.

(49) EXPLOSION-PROOF PANELBOARDS are described in Bulletin 661 including two all new series—EDP and ESP. Appleton Electric Co.

(50) LIGHTING. Outdoor lighting equipment catalog covers fluorescent floodlighting, mercury and incandescent floodlighting, fluorescent architectural lighting, hinged, rigid and davit poles. J. H. Spaulding Co.

(51) ROADWAY LUMINAIRES. Booklet B-8236 describes new quadroliner roadway luminaires and shows how the controlled lighting pattern can be applied. Westinghouse Lighting Div.

(52) POWER CONTROL UNITS, rated from one to 15 kva, are discussed in 8-page bulletin. Magnetics Inc.

(53) STAND-BY LIGHTS. 8-page catalog describes battery-powered stand-by lights and a complete line of accessories. Watchmaster Div., Carpenter Mfg. Co.

(54) LIGHTING. Brochure illustrates installations in hotels, motels, clubs, restaurants, and institutions. Jay Lighting Mfg. Co.

(55) FALLOUT SHELTERS. 4-page Folder F-171 answers basic questions about emergency electric power confronting the prospective fallout shelter owner. Onan Div., Studebaker-Packard Corp.

(56) LIGHTING STANDARDS. Octagonal tapered lighting standards for streets, parking lots, and building approaches, which accommodate fluorescent, incandescent or mercury-vapor luminaires, are described in new 28-page catalog. Millerbernd Mfg. Co.

(57) CODE COVER. Catalog No. SB-CK outlet protector cover, called code cover, which fits all standard 3-in. by 2-in. switch boxes and industry standard outlet box covers, is described in pocket size brochure. Appleton Electric Co.

(58) ASBESTOS WIRE. 14-page catalog describes Bronco asbestos-insulated electrical wires and cables. Western Insulated Wire Co.

NEW!

one package puts everything you need to

ANCHOR TO ANY KIND OF MASONRY

right in your tool box

RAWL CONTRACTOR KITS put the **drills, anchors,** and **screws,** in the sizes you need, on the job where you need them. Each kit contains a high-quality Rawl spiral carbide drill, 100 genuine Rawlplugs, and 100 matching pan-head screws . . . all in one sturdy, reusable box.

Rawl Contractor Kits come in three popular sizes . . . use the handy coupon to put one in each of your tool boxes.

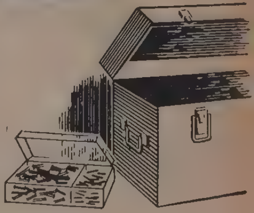
Kit No. R-8 includes:	**Kit No. R-10 (shown) includes:**	**Kit No. R-12 includes:**
100 #8 x 1" genuine Rawlplugs	100 #10 x 1" genuine Rawlplugs	100 #12 x 1" genuine Rawlplugs
100 #8 x 1" pan-head screws	100 #10 x 1" pan-head screws	100 #12 x 1¼" pan-head screws
1 #8(11/64") Rawl carbide drill	1 #10(3/16") Rawl carbide drill	1 #12 (¼") Rawl carbide drill

R 34

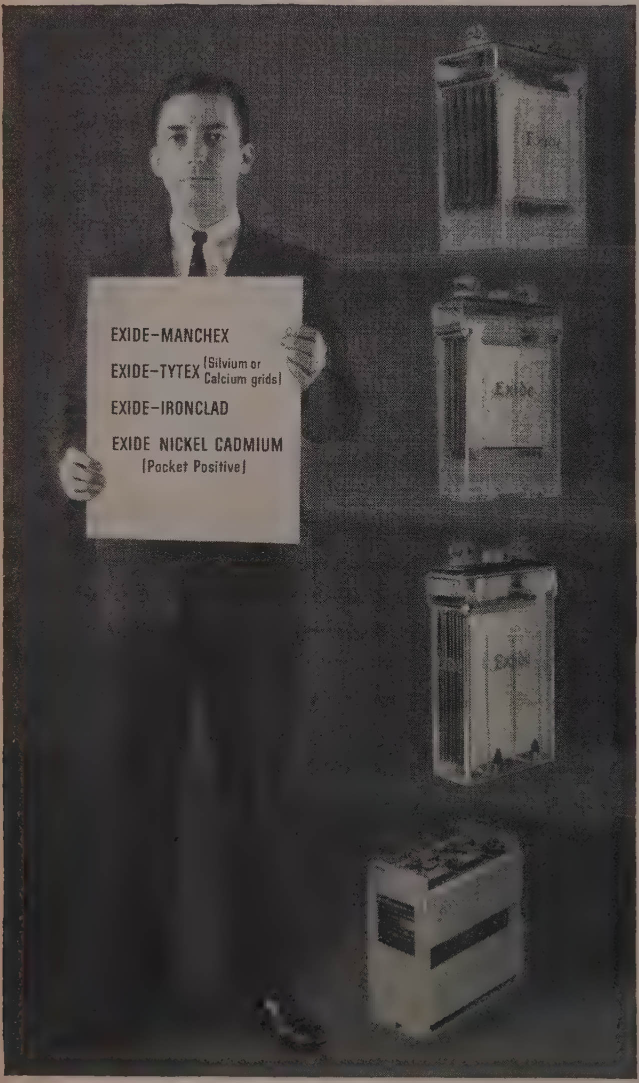
Ⓡ The **RAWLPLUG** Company, Inc.
212 Petersville Road, New Rochelle, N.Y.

Please rush ________ (quantity) R-8 Contractor Kits @ $4.13 $________
________ R-10 Contractor Kits @ $4.60 ________
________ R-12 Contractor Kits @ $5.40 ________
Total $________

Name ________
Firm ________
Address ________



One Exide battery fits in the least space. One gives the longest life. One has the lowest price. One costs least to maintain. Each is the smartest buy for certain applications. Which should you buy?


EXIDE-MANCHEX
EXIDE-TYTEX (Silvium or Calcium grids)
EXIDE-IRONCLAD
EXIDE NICKEL CADMIUM (Pocket Positive)
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Because Exide offers the broadest line of stationary batteries for the utility field, it can honestly recommend a size and type that best meets your own requirements. No one battery type is most suitable for every application—you need this broad selection to choose from. Talk with your Exide representative and get a battery recommendation based on engineering facts. For literature, write Exide Industrial Marketing Division, The Electric Storage Battery Company, Philadelphia 20, Pa.

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Your assurance of most dependable and economical battery power. It includes the battery you should have, a charger to match, and the service you need provided by factory-trained industrial battery specialists—all backed by Exide. It's the complete package you can buy with confidence.

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INDUSTRIAL MARKETING DIVISION
The Electric Storage Battery Company
ESB

(59) Lamp Guards. Bulletin describes new deluxe portable lamp guard line. McGill Mfg. Co., Inc., Electrical Div.

(60) Recorders. 12-page Bulletin GEA-6887A describes complete line of single and multi-pen null balance recorders and recorder-controllers. General Electric Co.

(61) Drives. Bulletin 110 describes the operation of syncro-range adjusto-spede drives ranging in size from 5 to 200 hp. Louis Allis Co.

(62) Electric Power conversion line, which converts single-phase to 3-phase operation, is covered in literature. System Analyzer Corp.

(63) Lighting. 52-page Buyer's Guide No. 60-C-9 for contractors contains descriptions of lighting fixtures. Day-Brite Lighting, Inc.

(64) Air Handling Troffer. Bulletin B describes the new triple-shell Lumi-Flo air handling troffer which provides lighting, heating, ventilating and air conditioning from the same concealed ceiling unit. Benjamin Div., Thomas Industries Inc.

(65) Power Cable. Catalog ES-106 decribes interlocked armor power cable including engineering specifications. Crescent Insulated Wire & Cable Co., Inc.

(66) Test Sets. Portable high current, low-voltage test units are described in 4-page Bulletin SD-361. Multi-Amp Electronic Corp.

(67) Pushbuttons. Oil-Tite flush pushbuttons are described in 8-page Booklet B-7356. Westinghouse Electric Corp.

(68) Cables. Technical brochure covers Hot-Spot 125C cables and offers information on how they should be used including quick selection tables to aid in size specification. Anaconda Wire and Cable Co.

(69) Illuminated Ceilings. Bulletin D describes Sky-Glo illuminated ceilings based on a 2- by 4-ft and 2- by 2-ft vinyl, polystyrene and acrylic diffusers. Benjamin Div., Thomas Industries, Inc.

(70) Electrical Insulation selection Chart DB-70A contains actual samples of 15 different Dutch Brand insulating tapes, as well as physical and electrical data on each. Johns-Manville, Dutch Brand Div.

(71) Lighting Fixtures. 24-page booklet entitled "Designs for 1962" contains the most popular of Day-Brite's fluorescent and incandescent fixtures for commercial and industrial use, grouped by categories. Day-Brite Lighting, Inc.

(72) Silicone Potting Compounds. 16-page Booklet S-23 describes the selection and use of the widely used RTV (room temperature vulcanizing) silicone rubber compounds and the new, transparent clear silicone potting compound, LTV-602. General Electric Co., Silicone Products Dept.

(73) Gear Motors. New catalog illustrates complete line of unidirectional and reversible gear motors. Electro Counter & Motor Co.

(74) Light Source. Bulletin LS-3 describes long-range light-source for photoelectric applications. Farmer Electric Products Co., Inc.

(75) Luminaire. Booklet B-8234 describes new general-purpose commercial fluorescent luminaire, called the Cleer-vue. Westinghouse Lighting Div.

(76) Safety Signs for all fields are described in new catalog. Ready Made Sign Co., Inc.

(77) Panelboards. 4-page catalog describes dimensions and ratings of new NBLP panelboards. Federal Pacific Electric Co.

(78) Electric Heating Elements, ranging from simple straight tubulars to intricate custom-engineering designs featuring forming or fins, are the subject of new bulletin. Heatrex, Inc.

(79) Transite Conduit. 6-page Folder TR-311A contains illustrated step-by-step instructions for installing Transite asbestos-cement conduit. Johns-Manville, Pipe Div.

(80) Lighting. 72-page Catalog M-166 entitled "Symphony of Lighting Styles" introduces their new line of decorative residential lighting fixtures. Moe Light Div., Thomas Industries Inc.

(81) Heat Pumps. Form 526 details automatic heating and automatic cooling with heat pumps. Chrysler Airtemp Div.

(82) Limit Switches. Over 20 Type L oiltight limit switches are described in 20-page Booklet No. LJ-48. Cutler-Hammer Inc.

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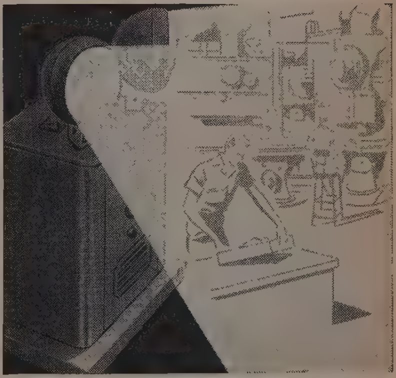
AGAINST LOSS OF LIGHT



EXIDE LIGHTGUARD®

Don't run the risk of heavy losses from sudden darkness. Panic, injury to personnel and customers, damage to valuable machines, thefts, can cost $1000s. Exide Lightguard goes on instantly and automatically when regular power fails. Low in cost. Easy to install. Just plug into regular outlet. Built-in battery charger keeps it always ready for use. Several models. See them at your distributor's. Or write Exide Industrial Marketing Division, The Electric Storage Battery Company, Philadelphia 20, Pa.

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The Electric Storage Battery Company
ESB

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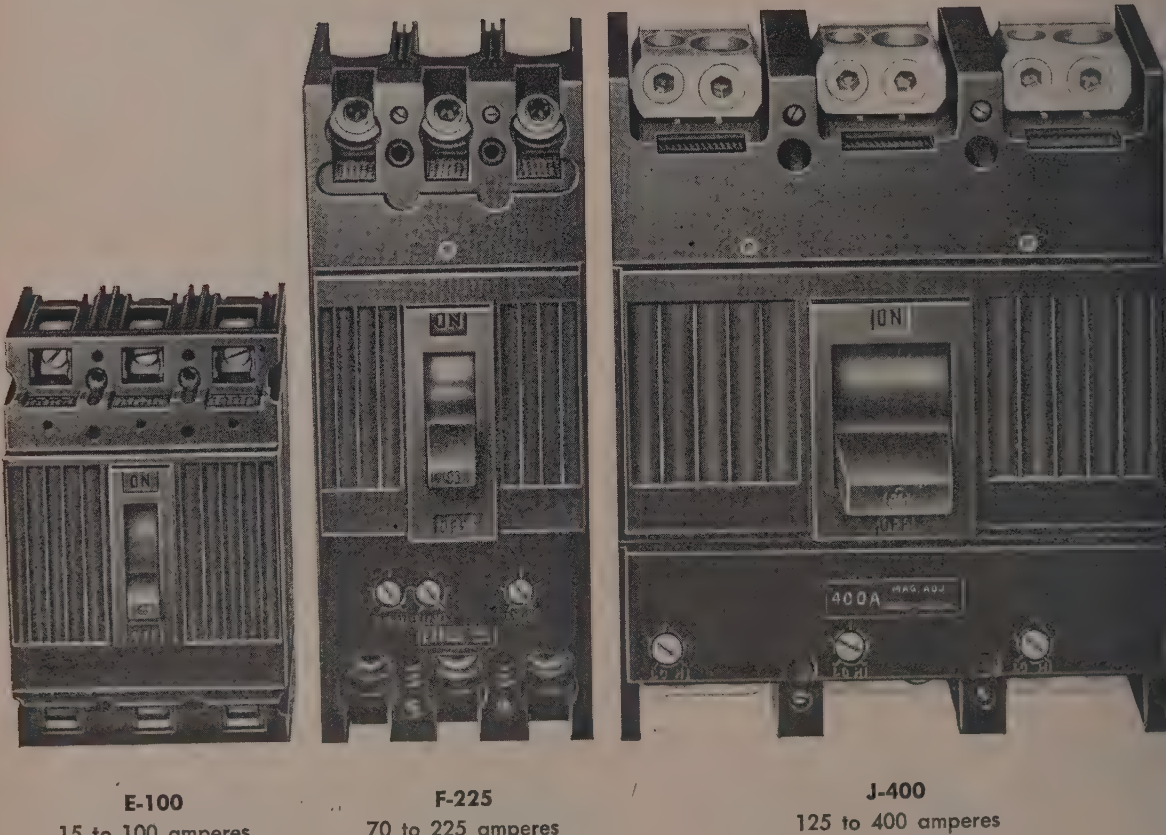
simple to select

15 to 1000 amperes
in just four frame sizes



E-100
15 to 100 amperes
240, 480 volts

F-225
70 to 225 amperes
240, 480, 600 volts

J-400
125 to 400 amperes
240, 480, 600 volts

Double-barreled versatility! Featured on new F-225 and J-400 lines: interchangeable trip models within each frame size permit change of rating even after breaker has been installed. Also available, fixed trip models where lower first cost is prime consideration. With G-E you zero in on *specific* requirements!

and apply... General Electric Circuit Breakers

K-1000
125 to 1000 amperes
240, 480, 600 volts

Available from stock now!

Now only four basic frame sizes cover every need from 15 to 1000 amperes. No more guessing games, no more confusion — selecting a circuit breaker from the G-E line is as easy as this . . .

E 100 LINE	15-100 Amp	J 400 LINE	125-400 Amp
F 225 LINE	70-225 Amp	K 1000 LINE	125-1000 Amp

This break-through in convenience is made possible by the new F-225 and J-400 breaker lines, which offer outstanding advantages like these . . .

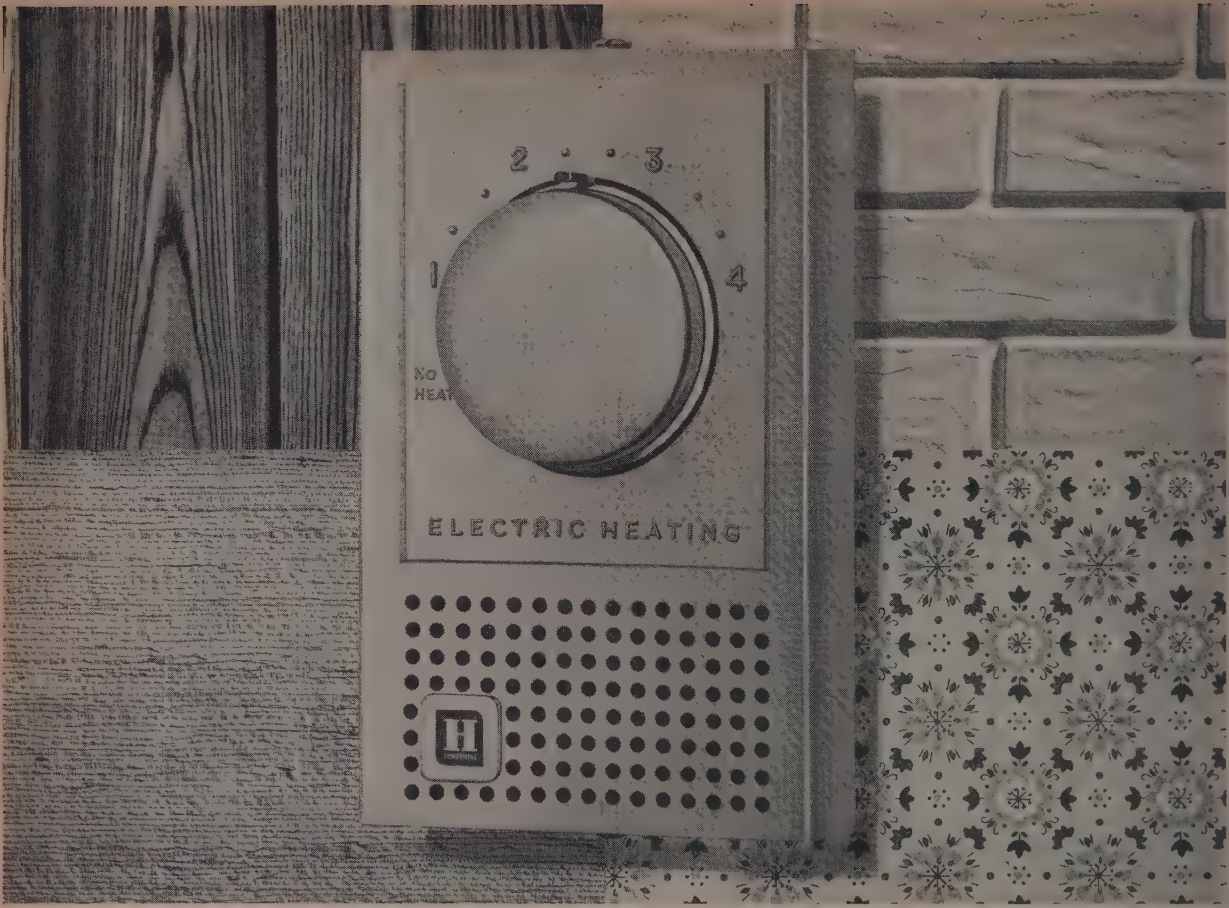
- **Ambient Compensation** — A standard feature. Permits installation in ambients up to 50 C without complex derating.
- **Front Adjustable Magnetic Trip** — Provides ± 10% accuracy at *all* settings, not just high or low.
- **Dual lugs** — Suitable for copper or aluminum wire.
- **Space saving up to 70 percent** over equivalent old styles.

Other features: field and factory installed accessories; NEMA 1, 1A, 3R, 4 and 5 enclosures; Hi-Break* 75 models (75,000 ampere I.C.) Vu-Break* Models (visible contacts); and magnetic-trip-only breakers for special requirements.

Easy to select, versatile, compact — all good reasons to specify General Electric circuit breakers for your next installation.

* Trade Mark of General Electric Company

GENERAL ELECTRIC



Put the Honeywell preference to work for you with the stylish

New Honeywell Line-Voltage Electric Heat Thermostat

When Honeywell is on the wall, you're offering what Homeowners want (3 out of 4 prefer Honeywell controls according to a recent survey in cities across the country).

The wall-mounted T462 (above) and its integral unit-mounted counterpart—the T460—are the ideal line-voltage home thermostats. New construction makes them stronger. Now easier to set, too. Rugged and dependable—yet precise (½° differential) switching for operating electric heaters up to 5000 watts, responding to both radiant and convected room heat.

Get the facts about Honeywell. Just call the nearest Honeywell office or write: Honeywell, Dept. EC2-25, Minneapolis 8, Minnesota.

Two switching variations available: T462A and T460C are SPST, make on temperature fall, break line in NO HEAT position. T462B and T460D have the added feature of breaking both lines in the OFF position.

Honeywell
Low-Voltage
Round

Consider Honeywell low-voltage controls, too. With versatile R8097 Relay, you can offer the widest range of low-voltage thermostat combinations in the electric heating industry...You have complete choice from the most economical to the famous Honeywell Round to the deluxe thermostats and Control Centers.

Honeywell

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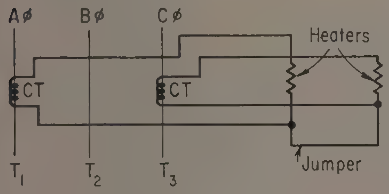
Reader's Quiz

QUESTIONS from readers on problems of industrial equipment, installations, maintenance and repairs. Answered by electrical maintenance engineers and industrial electrical contractors out of their experience. For every question and every answer published we pay $5.00.

Connecting CT Control Circuits

QUESTION N40—We recently installed some across-the-line Size 5 starters which had running overcurrent protection on two legs, and this current was reduced by CT's with a ten to one ratio so a small size heater could be used. On further examination I noticed a jumper, as shown on sketch, that connected the two heaters together.



No one was able to explain to me what this jumper was for. Would you please tell me why this jumper is used?—G.R.G.

ANSWER TO N40—It is a common practice to ground all current transformers to prevent a build up of high voltage. Usually this grounding is done by looping the ground wire from one transformer to the other. If a ground connection is added to the above circuit, at either end of the jumper, the jumper connection between the two current transformers makes good sense.—H.E.H.

ANSWER TO N40—The jumper will prevent a high voltage between the two heaters. This high voltage can increase the control voltage to ground. Furthermore, the jumper is usually connected to ground.—H.S.

Wye Circuits at 460 Volts

QUESTION P40—In our plant we have a delta-delta ungrounded transformer bank to supply power. Since we are building an addition to our facilities, we would like to take advantage of high-voltage lighting.

Is it possible to reconnect these transformers to 3-phase, 4-wire star, without sacrificing transformer capacity to a great extent? The three 200-kva transformers have no center taps. Primary voltage is 13,800 and secondary is 460. —S.M.

ANSWER TO P40 — One could write several pages of formulas and diagrams on why you shouldn't attempt to change the transformer connections of your present set up. But the important thing is to look elsewhere for the solution to your problem, which is providing a supply for your "high-voltage" lighting. By the term high-voltage lighting, I assume that you are referring to electric discharge lighting (fluorescent or mercury vapor) designed for 460Y/265-volt circuits.

Before discussing how this can be accomplished, there are a number of facts that must be uncovered if a proper engineering analysis is to be made to determine the most logical and economical installation. First, is there a single primary watt-hour meter for both power and lighting loads? If so, the problem is less difficult. Second, from the description given in your question, it is not known what type of lighting is presently used. Is the bulk of the present lighting fluorescent or incandescent? Third, is a separate transformer bank used for the lighting load (13.8 kv to 208Y/120 volts) or is the lighting load served by a transformer bank connected to the 460-volt system? Fourth, what is your present kva demand load? And fifth, what are the new load requirements?

Not knowing these answers, I would have to assume that you have a single primary meter, a separate lighting transformer, and that you have enough kva capacity in your 460-volt system to handle the new load.

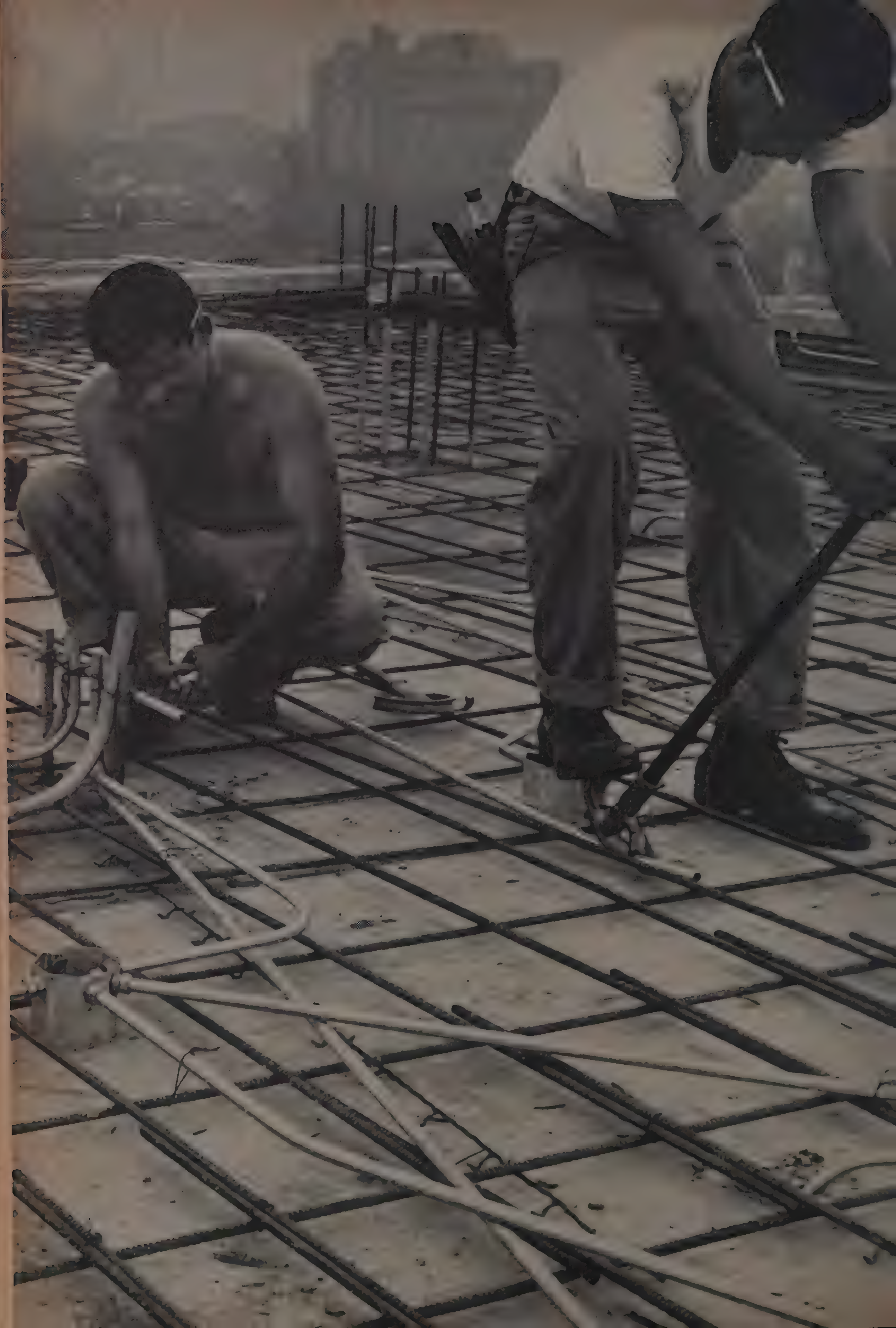
The new lighting can be provided in two ways, depending on the size of the load. If this lighting load is not too great, you could run a 3-wire, 460-volt feeder to the new addition and install a transformer bank to obtain a 208Y/120-volt supply. Or perhaps the existing lighting transformer has enough capacity to handle the added load, but here the feeder length would be a consideration. The reason that these points are discussed is that it is often advantageous—from a maintenance standpoint—to select new equipment that is the same type as the existing equipment. For example, the existing lighting could be 120-volt fluorescent liminaires; as a result, one should realize that new higher voltage fixtures will involve extra stock items. However, this may not be a major factor in your plant.

If it is determined that higher voltage circuits will best serve the new lighting, then the most logical solution would be to provide a zig-zag grounding transformer, which would be connected to the existing 460-volt supply. Then solidly ground the neutral of the grounding transformer. This will put the 460-volt system at 265 volts to ground from each line conductor. You will now have a grounded 3-phase system, and you will eliminate the many evils of an ungrounded system. With a grounded neutral system thus established, the supply does not exceed 300 volts to ground. As such, you can obtain fluorescent or mercury-vapor fixtures that have ballasts designed for connection to this 460-volt system. These ballasts are connected phase to phase on 3-wire 3-phase 460-volt branch circuits (AB, BC and CA). Obviously no neutral conductor is required in the feeder or branch circuits with this system. However, if 265-volt ballasts are desired, a neutral conductor must be added. The proper approach is to weigh the wiring and ballast costs of both systems. Either system is acceptable.—D.B.J.

Testing Insulating Oil

QUESTION Q40—We have several compensator auto transformer motor starters in our plant. The contacts are immersed in insulating oil. Is there a simple method which may be used to determine when oil must be replaced?—S.P.

ANSWER TO Q40—Usually, insulating oil used in compensators will turn dark in color because of the carbon deposit from the contactor arc. This will fall to the bot-



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low Republic ELECTRUNITE®
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dd it up. A split always wastes time, lways wastes money. It can stop a whole ob, could cost you plenty. Because Republic LECTRUNITE E.M.T. doesn't split or kink, ou get the job done faster, at lower installed costs, with full profit.

Uniformly round ELECTRUNITE fits the ender and bends evenly. If bent too much r in the wrong places it straightens out moothly. Troublesome hard spots in the teel are eliminated by the use of prime steel, nade and quality controlled in Republic's wn mills.

To this, add other exclusive features that peed measuring, simplify wire-pulling, help eep bends in the correct plane. You'll see vhy "The *Best* Costs *Less* Installed." Ask our Republic representative for a demonstration, or mail the coupon for complete nformation.

BENDS ARE SMOOTH and wrinkle-free with Republic ELECTRUNITE E.M.T. Photos show Keystone Engineering Corporation, electrical contractors of Philadelphia, Pennsylvania, working at Philadelphia's new Hawthorne Square Housing Project. More than 185,000 feet of ELECTRUNITE were installed in this project. Architects were Carroll-Grisdale and Van Alen.

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characterize
raceways made of
Galvanized Steel

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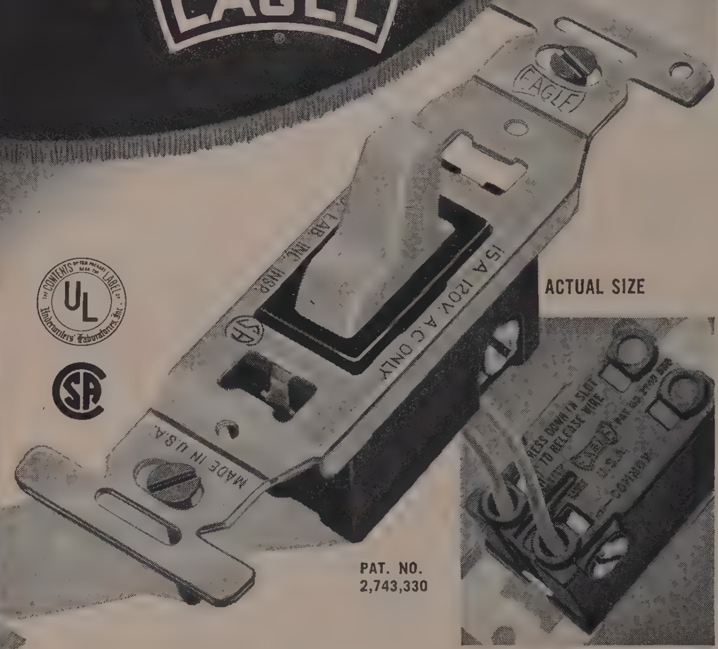
NEW
FROM EAGLE



The only competitively priced quiet switch with both screw and E-Z Wire® pressure terminals

Now you can meet both low-budget and premium quality requirements with this new EAGLE Toggle-Type Residential Quiet Switch. It operates on famous Eagle patented principle that provides "fast makes" and "slow breaks" through automatic mechanical action . . . not hand movement. Single pole and three way. Plaster ears. Takes #14 or #12 wire. *Has extra common terminal connections for continuous wiring.* For use in any position with all standard wall plates. Individually packaged in cellophane-wrapped Eagle "SHO-PAK". Also bulk packed on special request. Single Pole: No. 1021B — Brown; No. 1021V — Ivory. 3-way: No. 1023B — Brown; No. 1023V—Ivory. 15 AMP—120V—AC only. Meets Fed. Specs. Also available in TOUCH-A-MATIC types. Write for FREE sample and literature.

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"PERFECTION IS NOT AN ACCIDENT"

tom and build up on the insulating paper, which can be removed and cleaned periodically. With switches of this type, we try to inspect twice yearly, and replace the oil once a year. This insulating oil could be filtered, after which it could be used again.—E.S.H.

ANSWER TO Q40—A really simple test is the "color comparison test." A sample of the starter oil is compared to a sample of new, unused, but identical oil. Two glass beakers are filled with a sample of each oil and then are held up to a good strong light, one that is color corrected is preferred. North light could be used.

Darkening of the oil during its life could indicate a change in the oil itself. It does not follow, however, that dark oil is unfit for further duty.

But if you prefer a good test, resort to the "dielectric strength test." This combined with the color comparison will serve you adequately.—J.A.M.

Open-Delta Connections For Transformers

QUESTION R40—Given a 10-hp, 230-volt, 3-phase motor, delta hook-up with incoming power open delta, two legs read approximately the same amperage and one leg is much higher.

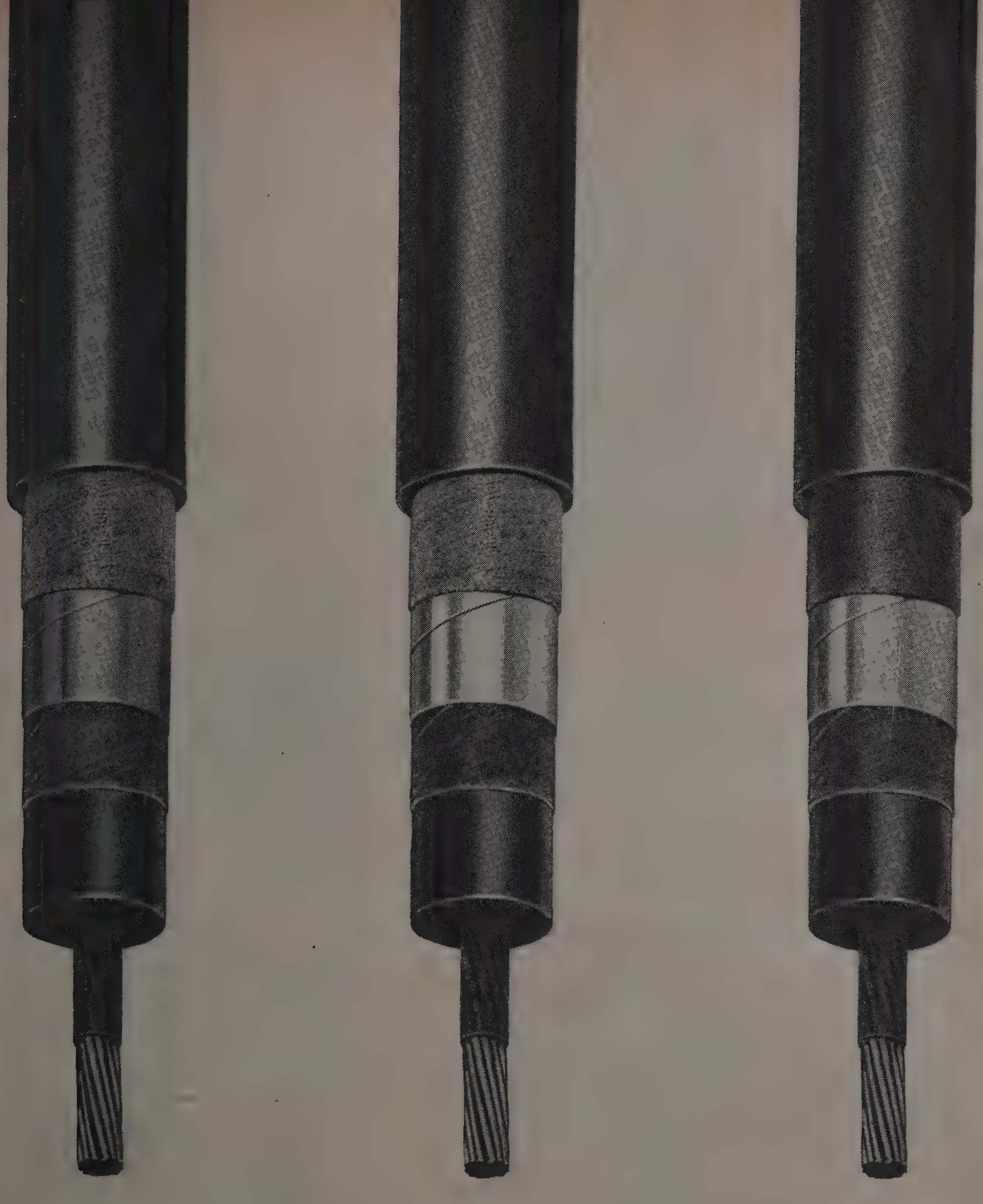
What causes this, and how can you determine if the motor is pulling proper amperage? Will a closed delta hook-up correct this and give a balanced condition?—C.W.R.

ANSWER TO R40—First and foremost, neither the open-delta power nor the delta-connected motor should cause your problem providing of course, everything is in order.

However, the following can cause unbalanced currents:

1. unbalanced supply voltage
2. dissimilar transformers
3. faulty motor.

A simple systematic procedure can be utilized to determine where the fault lies. First, check the transformers to see if they are identical in (a) voltage ratings, (b) kva rating, (c) impedance. Next, check the open-circuit voltage at the output of the open-delta transformers. Finally, try your motor on a standard delta or wye power system. By now you should have found the faulty piece of equipment through the process of elimination.—J.A.M.



Which one is the Circle cable?

It's the one in the middle. But, don't feel too badly if you guessed wrong. To the naked eye there is no apparent difference. Most power cables look alike. The big difference in Circle cable lies in the extra care taken in its manufacture...in the high quality of the materials of construction...and particularly in the stringent tests it undergoes to assure that it meets every rigid specification.

You'll notice the difference in the service you get from Circle power cable. On your next job be sure to specify Circle cable—there is no finer cable made.

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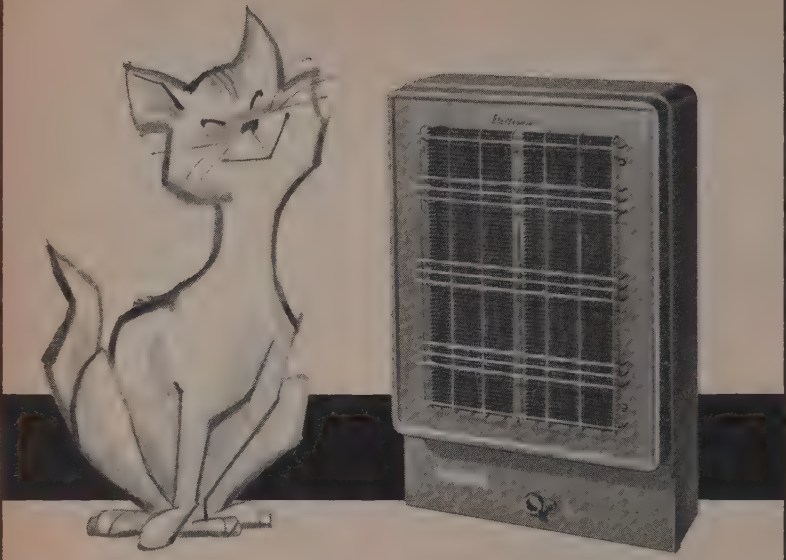
PLANTS: Maspeth and Hicksville, N. Y. **SALES OFFICES & WAREHOUSES:** In all principal cities.
Rubber Covered Wires & Cables • Varnished Cambric Cables • Plastic Insulated Cables • Neoprene Sheathed Cables • "CIRTUBE" EMT



a cat's 9 lives . . . and *Electromode* Heaters

Point up the contrast between a myth and a fact. It's a myth to assume little difference in various makes of electric heaters. It's a fact that today's ELECTROMODE Flameless Electric Heaters provide total heating efficiency throughout *one exceptionally long* and trouble-free life. Underlining this fact are two words: CAST ALUMINUM.

This is the long-life key. Electromode's exclusive Safety Grid. Only Electromode has it. All heating elements are solidly embedded in CAST ALUMINUM, forever safe, multiplying their service life many times—and assuring positive protection against fire, shock or burn. CAST ALUMINUM makes the world of difference! That's why, when you recommend the best in electric heaters—you have a mighty solid point in recommending Electromode. Write today for free literature on the world's most complete line of flameless electric heaters:

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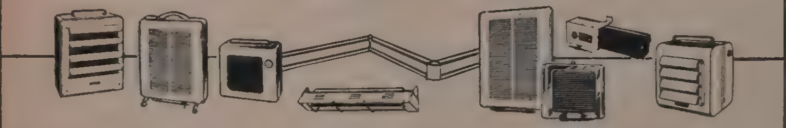


Can You Answer These QUESTIONS?

QUESTION X40 — I have come across varied opinions about the use of high-voltage shielded cables and the method of grounding. I would appreciate some expert advice.

This type of cable requires carefully made stress cones at each termination and at each splice. Some people say that all stress cones must be grounded. Others insist that the shield of each cable run should be grounded at one point only, to prevent excessive stray currents to flow in the cable shield. In this case only the stress cone at the line side of the cable is grounded. The length of the cable runs varies from short pieces to several thousand feet, with splices in many manholes. A third opinion is that it is better to use unshielded cable.

In the office there is usually very little or no information available about soil conditions with regards to stray currents, at job sites far away.—J.A.

QUESTION Y40—In a supermarket there is a row of 8-ft 2-lamp open fixtures with cool-white tubes. Some are 6 ft above an open meat display case. These were replaced with a pink lamp as the meat people claim cool-white or standard-white lamps "bleach" the meat.

1. Is this true or is it for color effect to fool the shopper (one color in our store, another in your kitchen)?
2. If the whites do bleach the meat through the plastic wrapper, do the pinks lower lumens or have different wave lengths?—E.R.

QUESTION Z40—At our plant we do considerable annealing of welds on pipe by making heaters of nichrome wire and using a dc welding machine. How can the cold resistance of the wire be converted to hot resistance in order to get the desired wattages?—E.K.

QUESTION A41 — Why is a 1:1 transformer safe to use in hospitals? I would like to know just what a 1:1 transformer is, and what are some practical applications?—S.L.

PLEASE SEND IN YOUR ANSWERS BY MARCH 15

y 15-months construction time was required to give shington, D. C. the nation's newest and most flexible or league stadium. Groundbreaking ceremonies were d July 12, 1960, and on October 1, 1961 the gates ned for the first football game. Only outstanding co- ration among the owners, architect, engineers, contrac- and suppliers made this unusual construction schedule sible. The 50,000-seat project uses 12,500 tons of structural steel, 7,000 moveable seats, the nation's largest scoreboard and 800 linear feet of refreshment stand counters.

The quality of the $24-million project is highlighted by the fact that 2136 Westinghouse floodlights mounted in eight individually aimed banks make this stadium more playable by night than by day—easily the world's finest example of outdoor sports field lighting.

You can be sure . . . if it's Westinghouse!

World's best-lighted sports stadium... powered by Westinghouse

(continued)

J-94184-1

World's best-lighted stadium . . . (continued)

Owner:
District of Columbia Armory Board
Architects and Engineers:
George L. Dahl, Dallas, Texas; Ewin Engineering Associates, Washington, D.C.; and The Osborn Company, Cleveland, O.
Electrical Contractor:
The Howard P. Foley Co.,
Washington, D.C.
General Contractor:
McCloskey and Company,
Philadelphia, Pa.
Westinghouse Distributor:
WESCO, Washington, D.C.

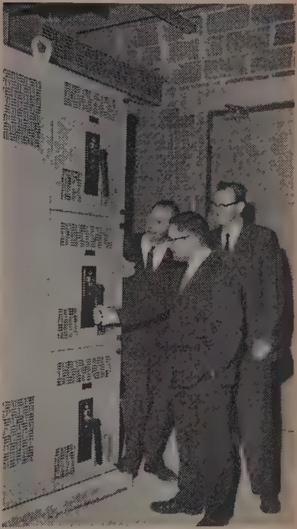
Special 90-volt power for the world's largest scoreboard is provided by three DS-3 60 KVA single phase dry-type autotransformers. Carl Staker and Maury Sardi review a double throw unfused safety switch that transfers the special voltage for night games. FDP fusible distribution panel feeds and protects scoreboard circuits. Compact, lightweight Westinghouse dry type transformers are easily transported and installed, require minimum floor area and practically no attention.

Viewing a line of 15-KV indoor metal-clad switchgear are Jack Korns, Carl Staker and Jim Miller, Westinghouse Headquarters Construction Engineer. Four 150-DH-250 air circuit breakers serve as main breakers on the normal and emergency incoming lines. Six new design 600-amp DFS units feed power centers and distribution transformer banks. Metal-enclosed, removable units safeguard operation and speed maintenance.

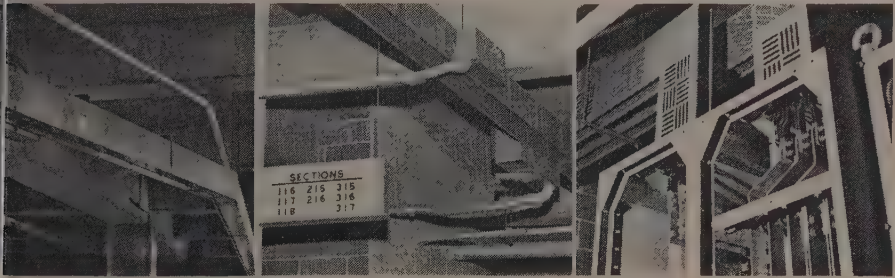
Each type VRC20 floodlight is aimed at a specific spot on the playing field to insure uniform illumination. Thatch Thurston, Westinghouse Lighting Engineer, directs the units with precise care. The largest of the eight towers—118 feet across—holds 360 units—and gives more light than the entire system of any non-professional stadium in the country. Stadium features dual lighting system, 800 floodlights being used for football and nearly 1800 for baseball.

Easy access to the lighting towers is proven by Carl Staker (top), Jack Korns and Gerry Nigro. Eight towers support 2136 VRC-20 floodlights each operated at 1740 watts. For baseball, the system provides 200 fc. for infield and 150 fc. in outfield. Floodlighting, free from harsh daytime shadows, makes it easier for players to see at night than day. Relamping is speeded by automatic latch feature of reflectors and swing-over bracket that returns unit to pre-aimed position.

Maury Sardi, Westinghouse, discusses operation of a DB-50 drawout air circuit breaker with Jack Korns, H. P. Foley Company, and Carl Staker, Resident Engineer, Dahl-Ewin-Osborn. The low-voltage switchgear is the secondary end of a 1000 KVA dry-type ASL Power Center, one of four that furnish 120/208 v, 3-phase power to bus duct for distribution through stadium.



Over 5,000 feet of plug-in bus duct circumscribe stadium on three levels, providing flexibility of power supply. Easy suspension from ceiling hangers made installation faster and simpler than conduit and cable—thus less expensive. Seen below: (left) typical run of 1000 amp plug-in bus duct; (center) Type TAP de-ion switches, rated 200 amps, serve as power take-offs and give feeder circuit protection; (right) bus duct connection to low voltage end of 1000 KVA power center shows advantages of Westinghouse coordinated equipment lineup. No on-site drilling or positioning of bus or connectors was required—installation was fast, positive.



J-94184-2

Eight roof-mounted transformer banks step 13.2 KV down to 120/208 V three phase for floodlight power. Westinghouse CSP type transformers contain an external lightning arrestor that protects against lightning or line surges. An internal AB breaker protects against overload and secondary fault. CSO oil switches mounted on the frame are used for electrical remote operation from the switchgear room. Open fused cutouts serve as manual disconnects for maintenance as well as overload protection for transformers

Discussing the components of an NLAB lighting panelboard are Gerry Nigro, WESCO salesman and Jack Korns. The Westinghouse panelboards contain a Quicklag® breaker arrangement that offer positive protection against possible short circuits or overloads. They feature immediate, visible indication of faulted circuits. Custom trim blends with the concourse area wall.

Westinghouse

Questions on the Code

Answered by:

R. L. LLOYD, *Electrical Safety Engineer, National Bureau of Standards, Washington, D. C.*
B. Z. SEGALL, *Consulting Electrical Engineer, New Orleans, La.*
R. E. WARD, *Chief Electrical Inspector, Insurance Department, State of Tennessee, Nashville, Tenn.*

READERS are invited to submit questions regarding the National Electrical Code and its practical application to this Department. Questions are answered by the consulting editor whose initials appear at the end of each item. The views and opinions expressed are, in each instance, those of the individual consultant replying and are not necessarily those of his employers, of this publication or of a Code-making committee or panel on which he may serve in an official capacity.

Terminal Identification

Q. *In the installation of at least one manufacturer's 3-wire devices, I find the terminals identified by having one copper plated terminal and two brass colored terminals. The same manufacturer states in their catalog that the copper-plated terminal on all their 3-wire devices is so identified for the convenience of the user and is intended for the connection of the neutral conductor.*

It has been my understanding for many years that the copper-colored terminal is the terminal for the ungrounded conductor. Am I in error in my thinking?—F.H.

A. Sections 200-9 and 200-10 pertain to the question raised. Section 200-9 states:

"Means of Identification of Terminals. The identification of terminals to which a grounded conductor is to be connected shall be by means of a metallic plated coating substantially white in color, such as nickel or zinc, or the terminals may be of material substantially white in color. The other terminals shall be of readily distinguishable different color."

Section 200-10 states in part:

"Identification of Terminals.

"(a) Device Terminals. All devices provided with terminals for the attachment of conductors and intended for connection to more than one side of the circuit shall have terminals properly marked for identification except as follows:

"Exception No. 1. Marking may be omitted where the electrical connection of a terminal intended to be connected to the grounded conductor is clearly evident.

"Exception No. 2. Single-pole Devices. Devices to the terminals of which only one side of the line is connected need not have terminals marked for identification.

"Exception No. 3. Panelboards and Devices. The terminals of lighting panelboards and of devices having a normal current rating of over 30 amps need not be marked for identification, except as required in Paragraph 200-10(b) for polarized receptacles for attachment plugs and polarized attachment plugs.

"(b) Plugs and Receptacles. Two-wire polarized receptacles for attachment plugs and polarized attachment plugs shall have the terminal intended for connection to the grounded conductor marked for identification.

"Exception No. 1. Two-wire attachment plugs, unless of the polarity type, need not have their terminals marked for identification.

"Exception No. 2. Three-wire Receptacles and Plugs. Three-wire attachment-plug receptacles and three-wire attachment plugs, one terminal of which may be used for the connection of a grounding conductor, shall have such terminal indicated in a manner differing from that specified in Section 200-9. The other terminals need not be marked for identification."

From the above you will note there are certain exceptions to the means of identification. In the Underwriters' Laboratories' "Standards for Safety for Attachment Plugs and Receptacles," which is their publication No. 498, there are exceptions made in line with the ones quoted above from the National Electrical Code regarding the identification of terminals.

Since receiving your inquiry I have checked with a distributor of the products mentioned and find that their grounding-type receptacle terminals are identified according to Section 200-9 of the NEC with a green colored terminal screw for connection of the grounding conductor with bright terminal screws for connection of the grounded conductor or conductors, and brass colored screws for the ungrounded conductor or conductors. I also found certain of their 3-wire devices to have terminals as is outlined in your statment. In my opinion these devices meet code requirements and would come under Paragraph 200-10(b), Exception No. 2.—R.E.W.

Service Extension

Q. *An existing multi-story building has a 6000-amp 120/208-volt service. A 1600-amp subdivision is installed to serve a new addition, which consists of a basement and sub-basement extending under and across the street plus two stories above grade after crossing street. There are no fire doors to the new addition. The 1600-amp subdivision is supplied from the existing main panel through a fused switch, and from the switch five runs of 3-conductor 700 MCM aluminum interlocked armored cables plus a run of one aluminum 2000 MCM bare conductor are used to supply the new addition. All five cables and bare neutral are installed in a galvanized steel ladder rack, which is supported from the ceiling by steel rods and is grounded to the frames of both the new load center and main cubicle by a 4/0 copper conductor. The connected load is about 800 amps for fluorescent lights and 400 amps for 3-phase and single-phase motors.*

(a) Would this installation be considered as a service or a subdivision of the existing building?

(b) What code violations exist?

(c) Could the neutral be given a free-air rating?—G.B.

A. In my opinion the five cables and the neutral would be considered as a feeder since there is a service-entrance fused switch located at the existing main panel.

The only code violation that I see is the use of a bare neutral feeder.

There is nothing in the code at present to cover this type of installation. My own opinion is that if the neutral was installed so that a free air space was maintained, i.e., all the cables and the neutral were definitely tied down to a fixed position with sufficient air space between the cables, rack and the neutral, and not thrown into the rack in a haphazard manner, then the neutral could be given a free-air rating.—B.Z.S.

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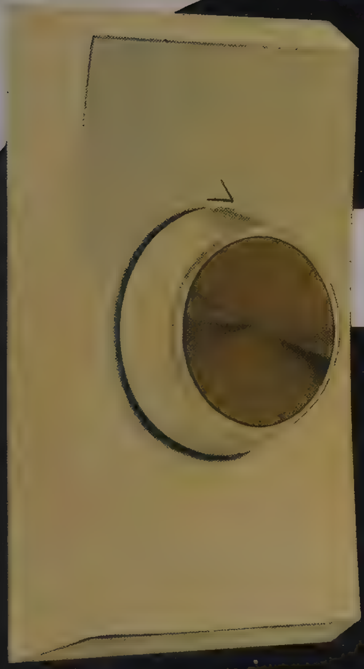

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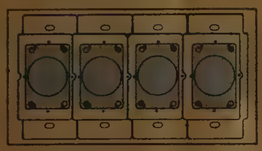

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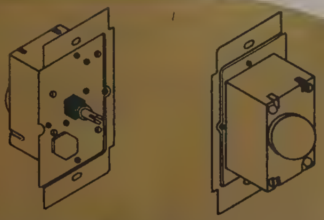

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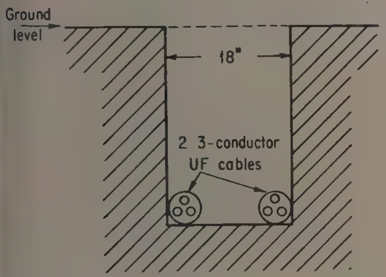
Cable Derating Factors

Q. *If two 3-conductor type UF cables are placed in opposite corners of an 18-in. wide trench, does a derating factor have to be applied?—F.G.M.*



A. The current-carrying capacity of Type UF cable is given in Tables 310-12 and 310-14 with Note 8 being applicable where more than three conductors are in a single cable. Because the limitation in Note 8 also applies to more than three conductors in raceway, it should apply to a group of bunched conductors buried together in a trench. It should, however, not be applied to cables which are sufficiently separated to allow heat dissipation such as would be the case where cables are separated by 18 in. of earth.—R.L.L.

NEC Interpretations

Q. *The National Electrical Code provides a procedure for interpretations of its text, and it is noted there are two general forms of findings. One is an interpretation of the literal text; and the other is an interpretation of the intent of the NEC Committee when a particular rule was adopted. It is also noted official interpretations carry numbers, such having reached over 460.*

Is there compiled printed material that is available to the public containing all the official interpretations?

What length of time does an official interpretation cover?

Is there provision for overruling of an official interpretation?—R.L.

A. Your questions concerning official interpretations are ones that need clarification as far as many in the electrical field are concerned. Your statement is true with reference to the two methods of interpretations, and this causes confusion in some instances. Of course, there is frequently room for an argument in the literal text

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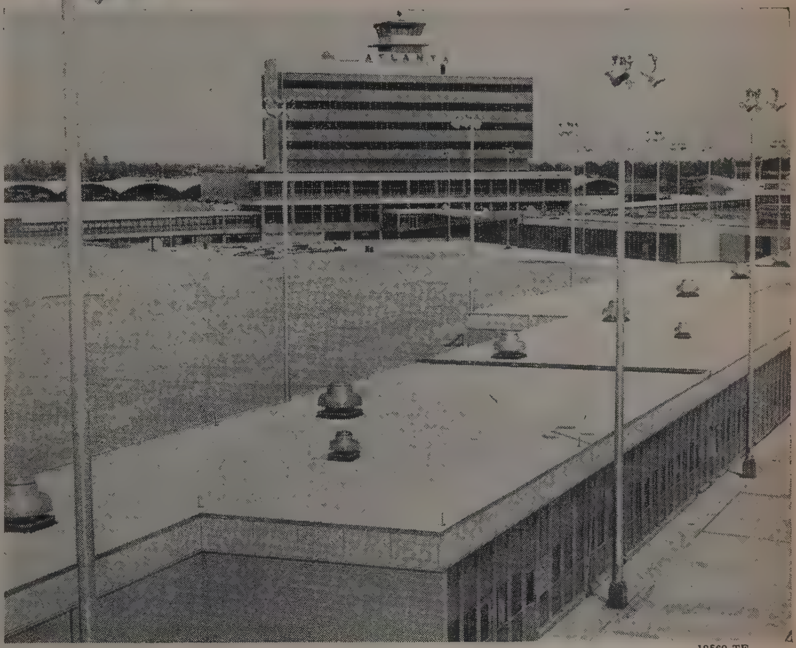

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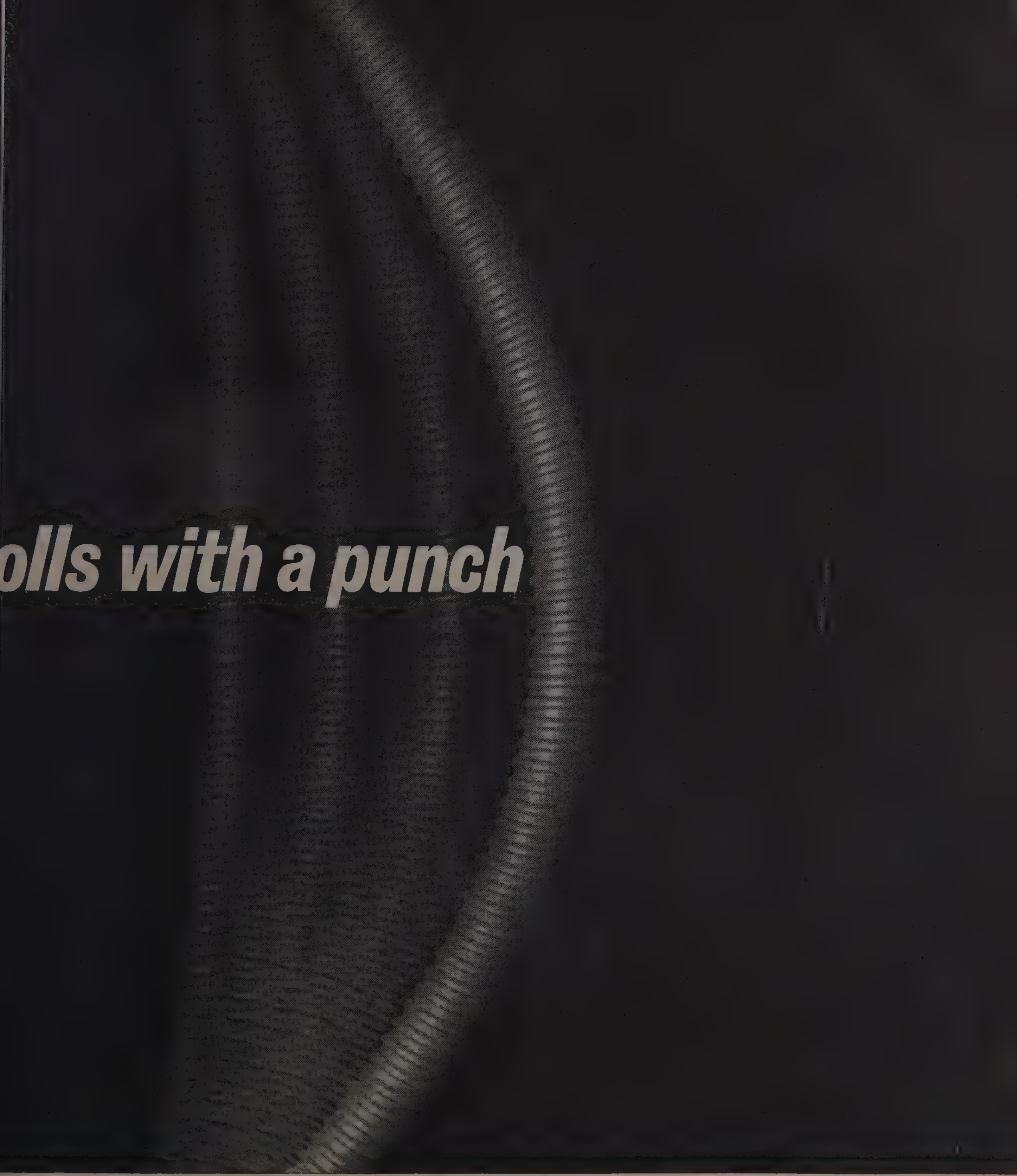

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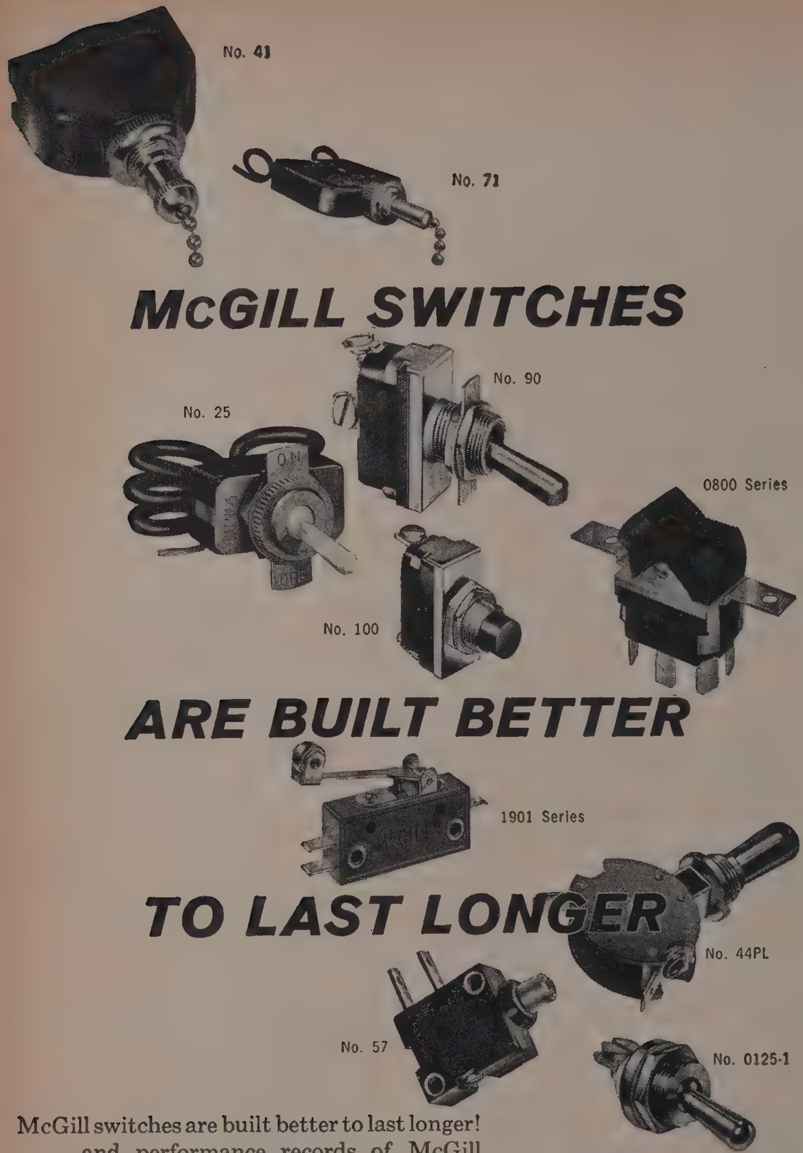

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of printed material, and in many instances this causes a request for an official interpretation. The second method regarding intent is one that can cause much concern. As an example, new devices and materials are developed continuously as a matter of progress. A code-making panel in making a rule cannot foresee what new materials may be developed and inadvertently prohibited or approved by the literal wording of such a rule. Therefore, in determining the intent, the Interpretations Committee must generally consider the safety features involved. This Committee knows that their interpretation may only apply until the next edition of the code. Also the chairman of the code-making panel involved is a member of the Interpretations Committee.

In answer to your first question, I am not aware of a publication containing ALL official interpretations.

Your second question concerns the length of time an official interpretation applies. Each interpretation is based on the edition of the code in effect at the time of the interpretation. In other words, an official interpretation that would be rendered at the present time would concern the wording of a particular rule in the 1959 NEC even though such wording may have been identical in previous code editions. After an official interpretation is rendered, the Committee on Interpretations reports to the Electrical Correlating Committee at its next regular meeting. The report covers the extent of concurrence among the members of the special committees in the findings covered by the report. The Chairman of the Correlating Committee then notifies the code-making panel that covers the subject on which the official interpretation was made. In turn, the code-making panel involved is expected to give due consideration to the text of any section or paragraph on which an interpretation has been made to the end that suitable revision of the text involved may be recommended if the panel deems it necessary. If the code-making panel finds that no change in the text is required, the existing wording will remain the same. On the other hand, should the code-making panel find the need for a clarification, which will necessitate a change in text, any such proposal would then be presented to the Correlating Committee in the same manner as any other change or revision.

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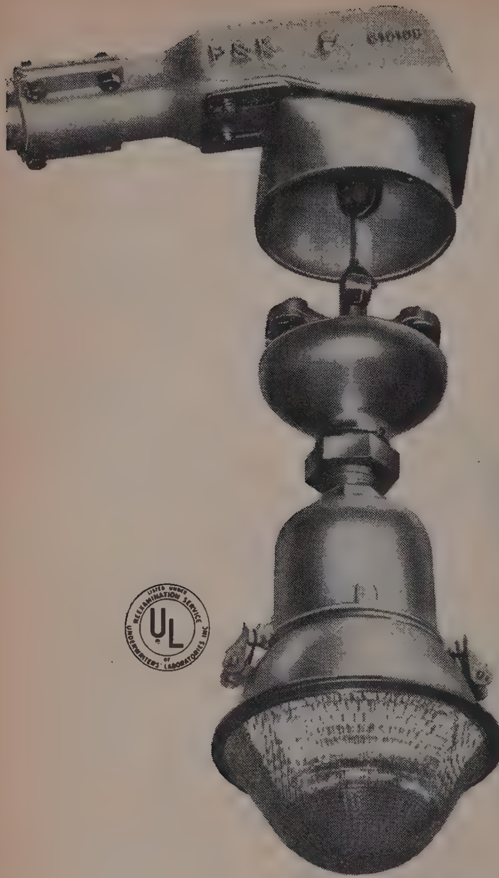

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members of the Interpretation Committee serve as volunteers and follow business-like methods in expediting the problems before them. They cannot be responsible for it coming to pass when authorities enforcing the NEC, or other electrical wiring standards, decline to acquiesce in or otherwise recognize the findings. The way is open, of course, for anyone to propose a code revision to correct the situation at issue. Any such proposals must be well documented to convince the Panel that revision is needed and in accord with the proposal made.—R.E.W.

Editor's Note:—About the nearest thing to a pamphlet, which contained official interpretations of the NEC, first appeared in the latter part of 1939. This pamphlet was issued by the International Association of Electrical Inspectors and covered interpretations of the 1937 Code and other previous interpretations that were thought to provide a clearer understanding of certain code rules. Thirty-two pages covered 64 previous interpretations in the IAEI pamphlet. The introduction read as follows:

"There appears herein Official Interpretations by the Electrical Committee to date with references revised to apply to the 1937 edition of the NEC. Many of the Interpretations heretofore issued have been omitted in this publication as the subjects under interpretation have been clarified by code revisions. Some of the older interpretations have been retained, however, as they may be of assistance toward a better understanding of the code.

"It must also be kept in mind that some of the Interpretations included herein were issued on the basis of previous codes. Any question arising as to the applicability of these particular interpretations to the 1937 Code may be the subject of a new interpretation.

"A revised compilation of NEC Interpretations will be issued with each new edition of the NEC. Interpretations issued by the Electrical Committee in the interim will appear in the successive issues of the IAEI News Bulletin."

It is apparent from the foregoing that the IAEI had fully intended to make similar pamphlets available to their members each time a new edition of the code was issued.

Subsequent to the 1939 IAEI pamphlet, similar pamphlets were issued in 1942 and 1943 by the NFPA and NBFU. These latter pamphlets applied to the 1940

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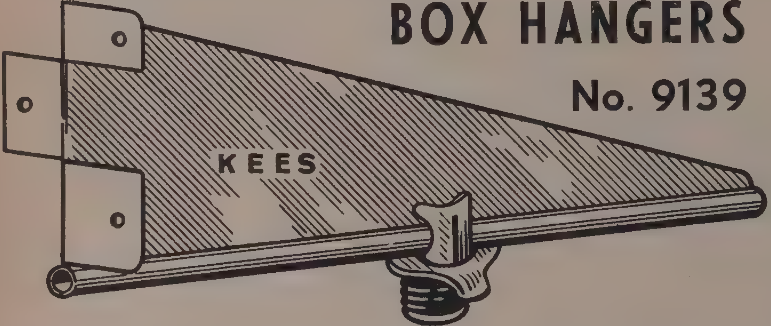

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NEC, and in addition to containing a number of interpretations, they also contained interim code revisions, applicable during World War II.

After the War, the next supplement, issued jointly by the NFPA and NBFU, was published November 1, 1949, and concerned the 1947 edition of the NEC. Since then, considerable controversy has existed in the industry as to the advisability of publishing interpretations on other than an individual basis. Moreover, it has come to pass that even some individual interpretations have not been PUBLICIZED. The reason for this is that some interpretations concern only a specific problem of special nature. Some code people feel that releasing such interpretations would cause more confusion if publicized.

Different schools of thought on publicizing interpretations still exist, and discussions concerning this subject are being debated presently.—J.H.W.

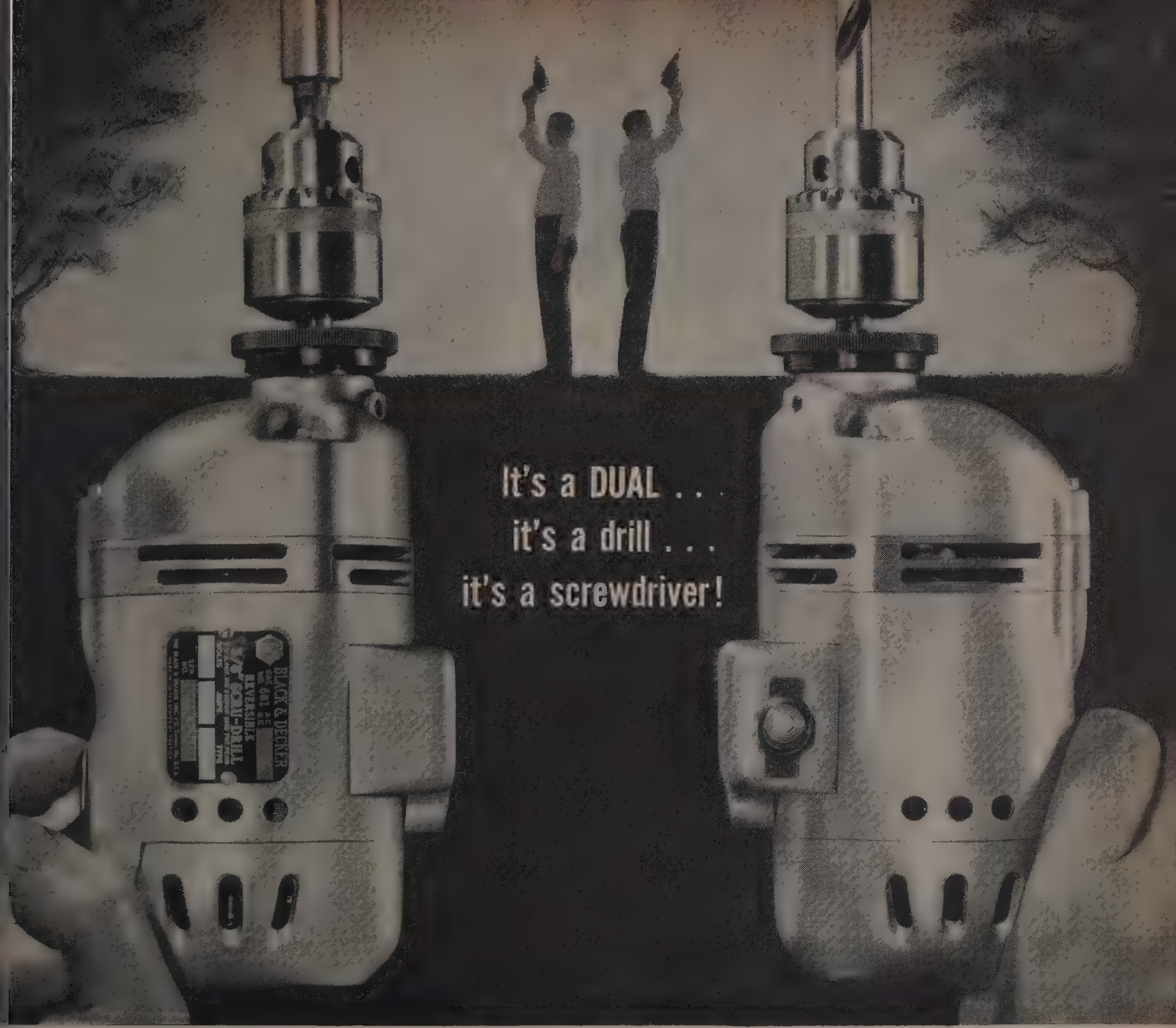
Multiple Conductors

Q. *The code permits 1/0 and larger conductors to run in parallel. Does this apply to multiple-conductor service cables when code rules are met for the paralleling of conductors, such as length and size of conductors?—H.B.*

A. As far as I am able to determine, there is no rule that would prohibit an installation such as you describe. I remember a similar question asked at one of the Southern Section IAEI meetings. The answer given by a member of the code panel at this meeting corresponds to my answer.—R.E.W.

Meters In Services

Q. *Essentially, Section 230-73 and Paragraphs 230-94 (b) and (e) specify under what conditions meters or related equipment (current transformers and/or potential coils) can be installed ahead of the service disconnecting means. Pinning down these code rules to a specific application, does paragraph 230-94 (b) mean that potential coils and current transformers (not a part of the meter proper) can be connected ahead of the service disconnecting means regardless of the supply voltage? Also, is it the intent of Paragraph 230-94(e) that*



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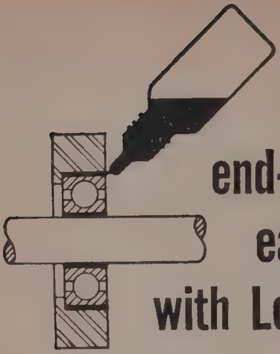

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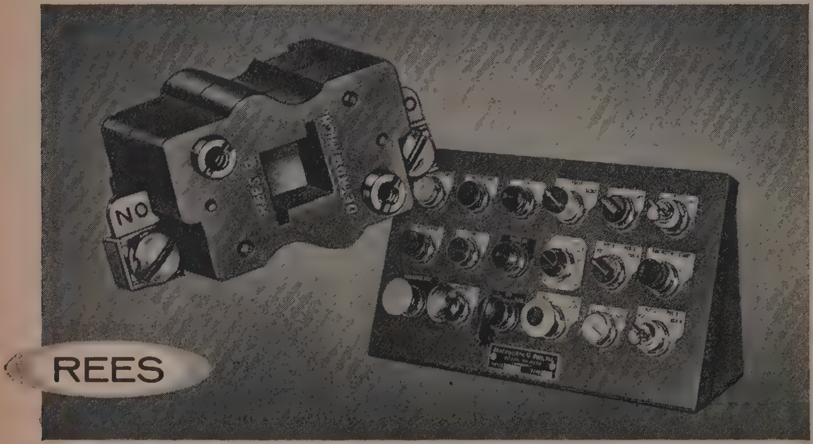

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this code rule anticipates the use of self-contained meters in which the meter itself contains a potential coil and current coils?—T.S.L.

A. Both sections cited specifically state that potential coils and current transformers may be connected ahead of the service disconnect. You are using the term "meter" in a rather broad sense, but I take it you are referring specifically to the utility's meter.

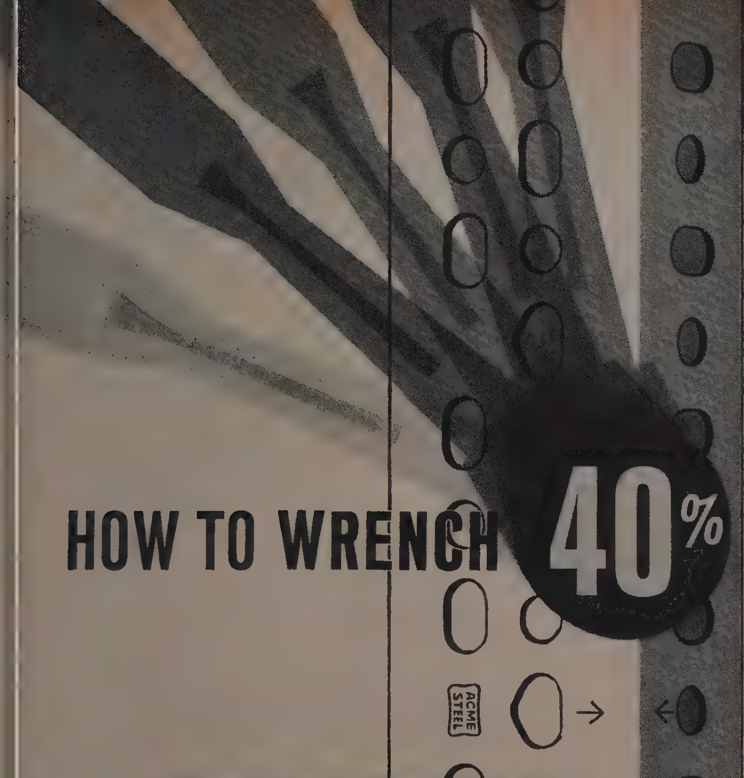
Regardless of your restriction to the watthour meter, Sections 230-73 and 230-94 do not restrict their application. Meters, in general, and instrument transformers, which include both potential and current transformers, may be connected on the supply side of the service disconnecting means.

As to your second question, it should be noted that Paragraph 230-94(e) does have a voltage limitation of a maximum of 600 volts. This paragraph, as stated, speaks of meters in the broad sense and would, therefore, include the self-contained watthour meter, which has both potential and current coils. —B.Z.S.

Grounding Connections at Boxes

Q. *What is the acceptable method of terminating the grounding conductor of non-metallic sheathed cable at an outlet box? —A.R.S.*

A. The grounding conductor which is usually bare when the cable jacket is stripped back or is identified by a green-colored covering or insulation, if furnished, may be attached to the outlet box by clips designed especially for this purpose. It may also be attached by means of a machine screw in a threaded hole in the box or by a bolt and nut. Where a grounding-type receptacle is mounted in the box, it is preferable to terminate the grounding conductor under the grounding screw (with hex head and and colored green) on the receptacle which is provided for this purpose. Where several cables terminate in the same outlet box, the grounding conductor of each cable should be connected together either by connection to the box, to a common terminal or preferably directly together by use of a pressure wire connecter, with one of the conductors extended and connected to the receptacle grounding terminal or to the box.—R.L.L.



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You secure savings as high as 40% thre simple ways:

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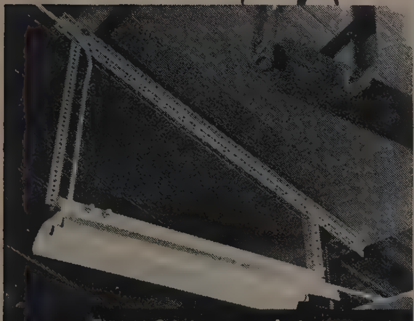

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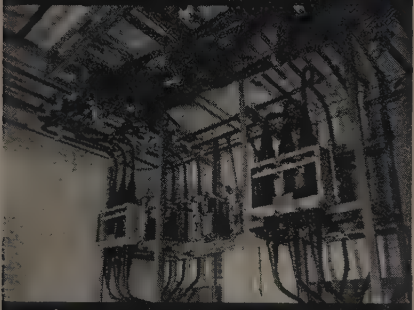

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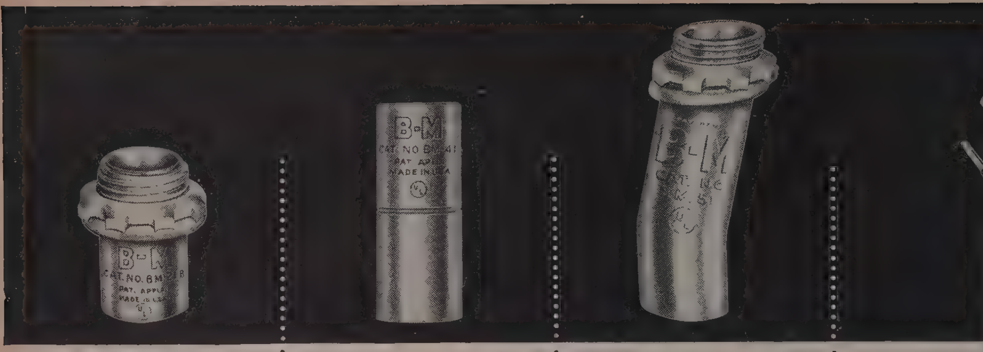

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showing how
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A few more of the plus features of B-M fittings are Concrete tight—Vibration resistant—Extra heavy bright zinc plate, salt spray and acid drip tested for corrosion resistance—Extra heavy positive bonding locknuts—smooth rounded edges or bushed throat type connectors that prevent insulation damage—All steel construction with extra heavy gauge wall thickness.

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When setting E.M.T. in concrete you can make each job easier and more profitable by using Briegel All Steel Indenter Fittings that have UL approval as Concrete-Tight. Contractors everywhere recognize their cost cutting qualities and the fact that they make each wiring job a better job. It is only natural that Briegel Fittings are the most widely used E.M.T. connectors and couplings.

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INDENTERS
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USED THE MOST FROM COAST TO COAST

In the News

Plant Maintenance Conference Held In Philadelphia

The 1962 Plant Engineering and Maintenance Conference and Show drew 20,000 visitors to the Philadelphia, Pa., Convention Hall, January 22 to 25. Over 400 exhibitors displayed an estimated 12,000 products and services designed to keep factories and machines running. Concurrent conference sessions heard a wide range of papers and discussions from 67 speakers and discussion leaders.

Industry has reached "the last stage of the industrial revolution," Harry Monroe, general foreman in charge of maintenance for the Rocketdyne division of North American Aviation, Inc., told his audience. Pushbutton machinery must be followed by pushbutton maintenance, the Canoga Park, Calif., executive continued.

He declared that maintenance can no longer be measured in terms of the cost of repairs. The cost of having a highly automated machine out of action because of a breakdown can reach staggering proportions. The burden placed upon maintenance is now measured in terms of cost per hour each machine is out of service for every hour of work scheduled for its operation, costs which presently vary from $25 to $300 for each out-of-service hour, he said.

But maintenance costs need not rise. There is no reason why the ingenuity of the plant engineering group could not accomplish the maintenance function to be as automatic, labor-free and cost-reducing as the equipment itself, declared Alexander M. Beebe, Jr., plant engineer for General Motors Corp., Rochester, N. Y.

L. C. Morrow, general chairman of the conference and consulting editor of "Factory," cited the effects of indirect costs on production costs. "During the period 1951-1961, the average hourly pay of carpenters increased 46%, of electricians, 50%; of mechanics, 44%; of machinists, 46%; of guards 50%; and of janitors, 43%. Similar increases were received by shipping clerks, secretaries, comptometer operators, senior draftsmen, and fork truck operators. Such increases are paid, not only directly by each company employing people in these occupations, but indirectly in the cost of materials, equipment and supplies that it purchases from other companies that have paid the increases directly," he said.

John R. Austenrieth, electrical division supervisor and electrical consultant, Sweeny Refinery, Phillips Petroleum Co., Sweeny, Texas, addressed one of the sessions on minimizing electrical equipment repair costs by the use of practical planned maintenance procedures.

New electrical methods, materials and maintenance procedures have made possible plant expansion without an increase in electrical maintenance manpower, he declared. In 1951, there were 17 electricians and supervisors combined who worked directly with electrical maintenance. Today, there are still 17 people directly associated with the electrical maintenance of the plant which requires ten times as much electrical power as in 1951. Then the electrical power consumption rate was 2,000 kw. Today it is 20,000 kw. Likewise, there were 500 electric motors, mostly small. Today there are 1,800 motors, many of which are fairly large, he said.

Among factors cited by the speaker as contributing toward increasing facilities without an attendant increase in electrical maintenance personnel were: work order planning and scheduling; better maintenance facilities; more easily maintained new-plant electrical equipment; better trained electricians under closer supervision and practical preventive maintenance programs.

Ground detectors are installed on all 440-volt, delta, nongrounded circuits to constantly monitor these circuits for ground faults, he said. With a portable ground fault locator, he continued, the fault can be found and identified without interrupting service until the equipment can be released for repair.

Group relamping has reduced time from 2-3 days a week for two men to the same time in a month, the speaker claimed.

J. W. St. Andre, formerly chief electrical engineer, Newark Works, Kaiser Aluminum & Chemical Corp., Newark, Ohio, and now associated with the Wesche Co., Cincinnati, Ohio, discussed problems connected with electric power distribution equipment.

"A visit to industrial plants throughout the country," he said, "will reveal that the great majority of plants distribute electric power over systems that are inadequate, outmoded and, in many cases, unsafe. When we realize the growth and dependability of the use of electricity in today's modern manufacturing plants, how can management be unaware of the failings of this important tool? The answer may very well be with electrical engineers in sales, design, consulting, and in plants in not doing a good job in selling the importance of good power distribution in everyday operation and productive effort of the plant."

The speaker suggested the use of power bills as a means of demonstrating the increased loads that systems carry often without adequate capacity. "Every unit of power has to flow over the power distribution system in the plant. Every ampere flowed through that circuit breaker that was adequate five years ago, but today it would explode if called upon to open up the circuit in case of a fault. The plant system grows and multiple circuits multiply the danger . . . the dangers pertaining to interrupting capacities of protective devices is not from the load they are protecting but from the load that can be fed into the circuit breaker when a short circuit occurs and which it must handle safely when opening the circuit," he warned.

G. W. Wagner, Philadelphia Electric Co., presented a discussion of practical developments in industrial lighting equipment and application practice.

J. S. Johnson, Westinghouse Electric Corp., presented a paper devoted to testing electrical equipment.

Local 3 Strike Wins "5-Hour" Day

On January 12, New York's giant IBEW Local 3 hit the bricks in a brief but historic strike, its first in 40 years. Directly involved were 6,750 members of its construction division, about 2,250 electricians from other areas working in its jurisdiction and 600 electrical contractors. Also threatened was the city's booming building industry and its 200,000 workers. Some 1,100 other licensed electrical contractors in the city, not under contract with Local 3, were not involved.

With a January 1 deadline, formal negotiations opened early in December. The existing contract provided a 30-hour week with five additional hours at time and one half to fit the prevailing basic 35-hour construction week. The rate was $4.40 an hour with about $2.20 more in benefits.

The local's opening demands called for a 20-hour week, which was not a surprise. But it quickly became evident that this was the key issue behind which union spokesman Harry Van Arsdale Jr. was ready to throw the full economic power of his union and his own substantial political influence.

The spectacular issue brought prompt headlines, television coverage and the white light of publicity to the bargaining sessions. The employers held the line, adamantly refusing to make any concession on the work week issue. The union refused to proceed to any other issue without a shorter work week. The deadlock led to a strike call for January 1, deferred on a legal technicality until January 12.

Two jobs were exempted, the Lincoln Center and the World's Fair. The union also provided men to handle temporary light and power to construction projects to minimize the immediate effect of the strike on other trades. Jobs were not picketed.

Local 3, backed by a mighty war chest, appeared to be digging in for a lengthy and costly contest. Late on January 17, the employer's solid front cracked. Greater City Electrical Contractors Association, a 120-member group, agreed to negotiate the shorter week issue. The other groups held the line for another day but late on the 18th a new agreement was reached and the strike was over.

The new contract becomes effective July 1, 1962 and continues for 30 months. It provides a 25-hour week with five more hours of guaranteed overtime at time and one half. The new rate is $4.96 and employees also gain a third week of paid vacation after 25 years.

A remarkable feature of the new contract is that the electricians apparently take a small reduction in weekly pay, from basic $165.00 for 35 hours to basic $161.20 for 30 hours. There is much speculation, however, that the practical outcome will be a continuation of the 35-hour week with the extra overtime bringing the weekly pay to $198.40.

FIRST AWARDS of Chicago Electric Association for promotion of electric comfort heating are received by James White, AAA Power, Inc., Addison, Ill.; Alfred Fragala, Airport Electric Co., Chicago; and Howard Brown, Brown Electric Service, Chicago. Dave Tunstall (Commonwealth Edison Co.) in role of Ben Franklin presented the Ben Franklin Award certificates to 29 electrical contractors and 10 home builders at the Electric Association's 1961 fall electric comfort heating conference.

Everett E. Carlton Named IAEI President

Everett E. Carlton, Menlo Park, Calif., is the new president of the International Association of Electrical Inspectors. He is chief electrical engineer, Division of Industrial Safety, State of California.

Mr. Carlton became a member of the Southern California Chapter, IAEI, in 1942 when he became affiliated with the Division of Industrial Safety, Department of Industrial Relations, State of California. He is a former member of the Southwestern Section IAEI Executive Committee and past-president of the Southwestern Section. Since his election to the IAEI Executive Council in 1956, he has risen steadily in official ranks to the IAEI presidency.

At present, he is a member of the Electrical Council of Underwriters' Laboratories, Inc.; member of the NFPA National Electrical Code Committee's Code-Making Panel 13 and chairman of Code-Making Panel 12. He is also a member of the recently reactivated IAEI Committee on Non-Interchangeable Circuit Breakers. Other industry committees on which he has represented IAEI include the NFPA Committee on Machine Tool Electrical Standards; and Technical Sub-Committees on 3-Phase Motor Protection, Raceway Fill and Heating of Conductors, and Study of Underwater Swimming Pool Lighting.

A graduate electrical engineer (BS in EE, University of California), Mr. Carlson is a registered professional engineer in California and a member of the American Institute of Electrical Engineers. Following a year of postgraduate study, he began his career in 1935 as a junior electrical engineer on construction of the Boulder Canyon transmission line for the Department of Water and Power, City of Los Angeles.

EVERETT E. CARLTON

During World War II, Mr. Carlton was a Lieutenant in the U. S. Navy serving as Radar Officer installing and maintaining shipborne radar in the Pacific Area.

Sievert Elected CCECA President

Carl W. Sievert, Sievert Electric Company, was elected president of the Cook County Electrical Contractors Association in Chicago. The new vice president is Thomas Wigdahl, Wigdahl Electric Company. Re-elected for another term were: secretary—A. L. Simons, Clark Electric Company; and treasurer—Bernard Braverman, Almart Electric Company.

New members of CCECA's Board of Directors are: Stanley Rutzen, Chicago Lawn Electric; Edmund Wozniak, Ed's Electrical Service; Arthur Norling, Ewald Electrical Construction Co., Oak Park, Ill.; Russell Hagstrom, Skokie Valley Electric Company, Inc., Skokie, Illinois. Other Board members, all from Chicago, include: Clyde Grove, American Electrical Construction Co.; Howard Brown, Brown Electric Service; Henry Bell, Commodore Electric Co.; Irwin Marks, D. D. Electric Co.; Joseph Kunst, Jr., Principle Electric Co.; and George Reinke, Geo. W. Reinke Electric Company.

MODEL 702 Electric Hacksaw with exclusive stock vise. For fast, accurate cutoff of bar stock, pipe and angle with minimum vibration. Holds ½" to 5½" material.

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- **Greater rigidity**—tightly braided jacket over improved core. Non-conductor!
- **Strong**—withstands one or two man pull.
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- **Lightweight**—14 oz. per 50 ft. Available in 50′ and 100′ lengths.

RIGID ROPE costs less than any metal tape designed for use in all types of conduit. (Polyethylene "Guide Sleeve" for outlet boxes included.)

*Patent Pending

New improved core

New metal eye

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Connect wire at either end!

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McGraw Award Medallists Honor L. K. Comstock

Louis K. Comstock, an organizer and director of the Council on Industrial Relations for the electrical construction industry and former president and director of the Merchants Association of New York, was honored on his 97th birthday, January 8, at a reception and dinner at the Walfdorf-Astoria Hotel.

The event was sponsored by the Committee of Awards of the James H. McGraw Award for Electrical Men, in recognition of Mr. Comstock's service to the committee since 1933 as chairman, and more recently, chairman emeritus. The Award has been given to 109 electrical industry men since it was founded in 1925. Attending were electrical leaders who had received the McGraw Award for outstanding contributions to the advancement of their industry in former years, members of the Committee of Awards, and representatives of national electrical industry associations.

Harold A. Webster, president of T. Frederick Jackson, Inc., and president of the National Electrical Contractors Association, was toastmaster. Donald C. McGraw, president of McGraw-Hill Publishing Company, whose father founded the Award, presented Mr. Comstock with a testimonial scroll. N. J. MacDonald, president, Thomas & Betts Co., Inc., Elizabeth, N. J., and former president of the National Electrical Manufacturers Association, speaker of the evening, recounted great achievements of the electrical industry and challenged his audience to create an industry image and environment attractive to the most talented of today's youth.

"In his long and fruitful lifetime," the citation read, "Louis K. Comstock has witnessed and actively participated in virtually the entire span of the great electrical industry. Pioneering in a field of technology which, in his early experience, was wholly novel and without precedent, he played a major role in translating engineering principles and laws into practical electrical systems. . . . In 1925, his industry associates called upon him to organize and direct an unprecedented venture into labor-management relations—the Council on Industrial Relations—which soon became, and is to this day, a model for peaceful and strikeless settlement of management-labor problems. In recognition of this achievement, he became the first electrical contractor to receive the James H. McGraw Medal for his conception of a medium for reconciling differences between employer and employee in the electrical construction industry."

A native of Kenosha, Wis., and an alumnus of the University of Michigan (class of 1888), Mr. Comstock, in 1904, organized L. K. Comstock & Company, Inc., New York City, where he remained as president until 1926 and chairman of the Board until 1940, when he retired.

Mr. Comstock also had served as chairman of the board of directors of the New York Title Insurance Company, 1934-38; director, Realty Mortgage Servicing Corporation, 1938; director, United Cigar-Whelan Stores Corp., 1937; vice-president and director, Montclair Savings Bank, Montclair, N. J., 1938, and president and director, Merchants Association of New York, 1925-1939. During World War I, he was a member of the War Industries Board.

CONTRACTORS attending the James H. McGraw Award dinner were Louis Kalischer, Brooklyn, N. Y.; J. W. Frommer, New York City; L. K. Comstock; H. A. Webster, Long Island City, N. Y.; A. H. Wilson, Washington, D. C.; E. C. Carlson, Youngstown, Ohio; O. F. Burnett, Jr., Phoenix, Ariz.; and P. M. Geary, Washington, D. C. Also attending were A. L. Bush and D. J. Crimmins, New York.

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EASA's TREASURER Alex A. Shovan, (left) Industrial Electric Service, Hawthorne, N. J., learned that his successor as national director needed no introduction to the board members at a recent meeting in St. Louis. He is William J. Wheeler, Sr., The Maintenance Co., Long Island City, N. Y., a past-president of the association and for many years a member of the board of directors.

EASA News

Jerome P. Miller, co-owner of Electric Motors Unlimited, Madison, Wis., was honored in January by the Electrical Apparatus Service Assn. as "EASAN of the Month," a new monthly award that is being given to members, other than national officers and directors, in recognition of their service to the organization and the independent electrical apparatus service industry.

Mr. Miller is secretary-treasurer of EASA's Wisconsin Chapter, a post he has held since 1957. He went into business with partner David Thornell in 1951 after several years' training with other repair shops in Madison.

• • • •

A new region, encompassing the areas in Colorado, Wyoming, Utah, Nebraska, Kansas, New Mexico, Idaho and Nevada covered by the Rocky Mountain and Utah Chapters of EASA, has been approved by the association's membership in recent balloting. Elected director to serve the new region was Lynn Silver, Silver Electric Co., Salt Lake City, Utah. Mr. Silver's election brings the number of directors of EASA to 17.

• • • •

Ben J. Horton, Pittsburg, Kansas, was selected to head a new slate of national officers that will assume office next June at the 29th Annual Convention in Chicago. Mr. Horton, currently EASA's international vice-president, will serve as EASA's president for one year ending in 1963. With Mr. Horton the following will also serve: Joseph F. Ferrari, Chicago, vice-president; Arthur G. Bamford, Kitchener, Ont., secretary; and Walter G. Brush, Birmingham, Ala., treasurer.

• • • •

Reports from the Gulf area that had been struck by Hurricane Carla last September indicate that repairs are still being made on electrical apparatus that had been flooded by the disaster. In many cases, emergency repairs had to be made to get factories and other industrial concerns back into production quickly, necessitating temporary repairs. Many of these motors have since burned out and have been returned to the shops for rewinding, a procedure the customers understood would be necessary. EASA shops in Houston, Corpus Christi, Beaumont, Port Lavaca, Freeport, Galveston and Port Arthur, Texas, worked around-the-clock shifts for many days after the storm, and suppliers stayed open week-ends to provide badly-needed materials.

Many shop owners suffered damage to their business and personal property, but none was injured and all were grateful that their losses although heavy in many cases were relatively light compared with the vast destruction that Carla wreaked throughout the coastal area. One owner, Harold McIntosh, McIntosh Marine Service Co., Beaumont, Texas, who lost a valuable beach house in the storm summed up the feelings of many when he commented: "In view of the severe damage and losses of some of our good friends in this area, we were indeed fortunate."

• • • •

The shop owner who will travel the longest distance to attend the new series of Electronic Motor Control Course EASA in February, March, April and May, undoubtedly will be Ken Yee, Ken's Electric Motor Service, Honolulu, Hawaii. Mr. Yee will attend the basic course to be held in Seattle, Wash., February 12-16 and the advanced course in San Francisco, May 21-23.

The Seattle course is one of three basic courses scheduled this year, the others including one that was held in Cleveland and another that was held in Houston last month. The advanced courses are scheduled to be held in New York City, March 12-14; Chicago, April 9-11; Atlanta, Ga., April 23-25; Dallas, Texas, May 7-9; and San Francisco, May 21-23.

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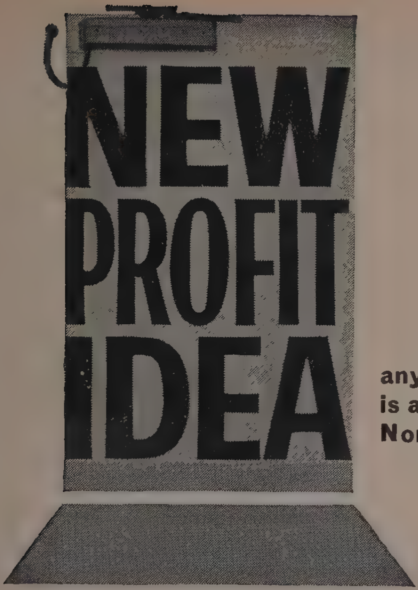

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NORTON® AUTOMATIC DOOR OPERATORS CAN HELP YOU CLEAR AT LEAST $200 EXTRA ON EVERY SALES CALL YOU MAKE

New, simplified Norton automatic door operator kits assure fast, low cost installation (you get paid for that, too), and you don't have to worry about service (Norton assumes responsibility after the equipment is installed).

WHAT IT IS. A simple, fully automatic foot-activated door operator. Easy to install. Self-contained, compact unit needs no auxiliary equipment. The Norton operator can be quickly applied to any new or existing door.

HOW IT WORKS. In any high traffic spot, foot traffic alone operates the door. (The Norton operator is also available with many other types of switching equipment). You sell it easily, you install it easily. Just bolt to door, install mats, connect wiring, and plug it in.

WHO CAN USE IT. You can sell this profitable door operator to increase sales with your present customers. You can use it to sell accounts you never sold before. The new Norton kit gives you the opportunity to branch out through another line of equipment that fits any retail or commercial stores, any school, hospital, service organization, any public or industrial building. Norton will support your sales efforts with extensive trade advertising.

NORTON *Automatic* DOOR OPERATORS

SEND FOR DETAILS NOW. The Norton Automatic Door Operator Kit provides the lowest *installed* cost of any door operator you can offer your customer. Its installation ease and freedom from maintenance means profit for you. A possible $200 profit on every sales call you make. Send coupon below for all the facts.

NORTON DOOR CLOSER COMPANY ECM-22
Division of The Yale and Towne Mfg. Co.
372 Meyer Road, Bensenville, Illinois

I am interested in selling and installing Norton surface-mounted automatic door operators. Please send details on your dealer proposition and application for dealership.

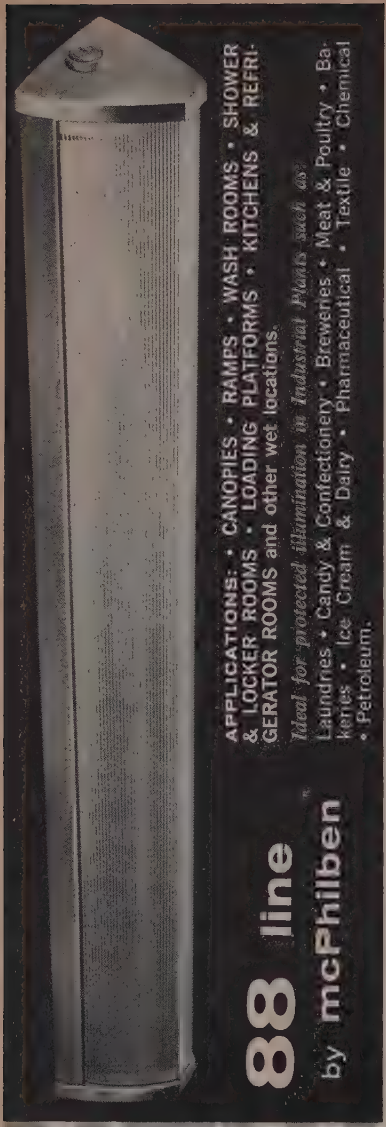
Name________________Title________

Company____________________

Address____________________

City____________Zone___State________

1929


APPLICATIONS: • CANOPIES • RAMPS • WASH ROOMS • SHOWER & LOCKER ROOMS • LOADING PLATFORMS • KITCHENS & REFRIGERATOR ROOMS and other wet locations.
Ideal for protected illumination in Industrial Plants such as:
Laundries • Candy & Confectionery • Breweries • Meat & Poultry • Bakeries • Ice Cream & Dairy • Pharmaceutical • Textile • Chemical • Petroleum.
88 line
by mcPhilben

NEW 88 line
weathertight
protected
fluorescent

ideal for exterior, interior and wet locations where corrosive vapors and severe weather conditions prevail.

• extruded aluminum construction • weatherproof enclosed and gasketed, dust free, bug tight, moisture proof operation • satin anodized finish • 1/8" thick prismatic arylic diffuser • choice of one or two lamp Series in 4 ft., 6 ft., 8 ft. heights • High Output, Slimline or Rapid Start • single units or continuous runs available with Clevis type brakets for pendant, ceiling and wall mounting.

Sweet's S 32a/Mc

Contact your mcPhilben Representative or ask for complete specification data.

mcPhilben
LIGHTING
1329 Willoughby Ave., Brooklyn 37, N.Y.

Electric Products Co., Detroit, Mich., has been assumed by Mrs. Alice V. Johnson, wife of the firm's former owner, the late Charles Johnson, and John K. Cleary, Mrs. Johnson's brother, who has been manager of the firm for the last 18 years.

• • • •

Erwin R. Johnson has been named vice-president and general manager of the S. J. Stewart Electric Co., New Orleans, La. He has been employed as a sales engineer by the 62-year-old company that was founded by the late S. J. Stewart since 1957, and in recent years was also office manager.

• • • •

An increasing number of motor shops are preparing attractive brochures to advertise their services. A typical mailing piece will describe, step by step, the procedures involved in rewinding a motor, every operation from receiving through painting. As one owner, Mike Assalone, of Florida Electric Motor Co., Miami, Fla., recently put it: "People had no idea what is involved in winding a motor until they saw our message. Already we can trace work directly to our brochure." Other owners report similar results.

Electrical Show In New York

One of the important events in the electrical industry this year will be the National Electrical Industries Show, scheduled to be held in New York City, at the Coliseum, March 11-14.

This is a broad-based exposition covering every phase of the electrical industry, and is the sixth such show to be held since World War II. The last such show was held in 1960, and attracted over 22,000 electrical men from every state in the union plus 30 foreign countries.

This year's National Electrical Industries Show will concentrate on electrical construction materials and electrical apparatus, except for lighting. Over 300 exhibits will display the latest electrical products, many of which will be shown for the first time.

This four-day show is open by invitation only to electrical distributors, contractors, electricians, engineers, maintenance men, builders, and other members of the electrical industry and its allied field. Sponsor of this show is the Eastern Electrical Wholesalers Association.

DATES AHEAD

National Electrical Week—National Promotion, February 11-17.

Air Conditioning, Heating and Refrigeration Industry — 12th exposition, Great Western Exhibit Center, Los Angeles, Calif., February 12-15.

Upper Midwest Electrical Industry Convention — Radisson Hotel and Municipal Aud., Minneapolis, Minn., February 18-21.

National Conference on Application of Electrical Insulation—Shoreham Hotel, Washington, D. C., February 19-21.

18th Annual National Wiring Sales Conference—Atlanta-Biltmore Hotel, Atlanta, Ga., February 22-23.

Sacramento Valley Electrical League—Progress in Electrical Equipment Exhibit, Sacramento Inn, Sacramento, Calif., February 28-March 2.

National Rural Electric Cooperative Assn.—20th annual meeting, Convention Hall, Atlantic City, N. J., March 5-8.

International Association of Electrical Inspectors—Chapter Meetings—Mississippi, Heidelberg Hotel, Jackson, Miss., March 5-6; **Wisconsin**, Schroeder Hotel, Milwaukee, Wis., April 5-6; **Ellis Cannady**, Carolina Hotel, Raleigh, N. C., April 10-11; **South Carolina**, Andrew Jackson Hotel, Rock Hill, S. C., April 16-17; **Georgia**, Wanderer Motel, Brunswick, Ga., April 19-20; **Alabama**, Stafford Hotel, Tuscaloosa, Ala., April 23-24; **Five Chapter Joint Meeting**, Captain Shreve Hotel, Shreveport, La., April 26-28; **Tennessee**, Andrew Jackson Hotel, Nashville, Tenn., April 30-May 1; **Florida**, Jack Tar Harrison Hotel, Clearwater, Fla., May 4-5; **Virginia**, Hotel John Marshall, Richmond, Va., June 18-19; **Southern Section**, Tutwiler Hotel, Birmingham, Ala., October 15-17.

Sixth National Electrical Industries Show—New York Coliseum, New York, N. Y., March 11-14.

2nd NEMA National Electric Comfort Heating Exposition and Symposium—Sherman Hotel, Chicago, Ill., March 19-21.

11th Biennial Electrical Industry Show & Lighting Conference—Shrine Exposition Hall, Los Angeles, Calif., March 28-31.

Edison Electric Institute—Sales conference, Edgewater Beach Hotel, Chicago, Ill., April 2-4.

Electrical Association of New Orleans Southern Electrical Exposition—Municipal Auditorium, New Orleans, La., April 2-4.

Southern West Virginia Home Show—Civic Center, Charleston, W. Va., April 4-8.

Rocky Mountain Electrical League—Spring conference, Harvest House, Boulder, Colo., April 15-17; Fall convention, The Broadmoor, Colorado Springs, Colorado, October 14-18.

National Association of Electrical Distributors — Convention, Pittsburgh, Pa. May 12-16.

Pacific Coast Electrical Assn.—Annual convention, Ambassador Hotel, Los Angeles, Calif., May 16-18.

National Fire Protection Association—66th annual meeting, Sheraton Hotel, Philadelphia, Pa., May 21-25.

Edison Electric Institute—Annual convention, Atlantic City, N. J., June 4-6.

Electrical Apparatus Service Association—Convention, Conrad-Hilton Hotel, Chicago, Ill., June 10-13.

Los Angeles Home Show—Memorial Sports Arena, Los Angeles, Calif., June 21-July 1.

American Society of Heating, Refrigeration & Air Conditioning Engineers Inc.—69th annual meeting, Deauville Hotel, Miami Beach, Fla., June 25-27.

N. Y. State Assn. of Electrical Contractors & Dealers—Annual convention, Whiteface Inn, Lake Placid, N. Y., July 2-7.

Western Electronic Show & Convention — Memorial Sports Arena, Los Angeles, Calif., August 21-24.

American Home Lighting Fixture Month—National promotion, September 1-30.

Illuminating Engineering Society—National technical conference, Statler-Hilton Hotel, Dallas, Texas, September 9-14.

Canadian Electrical Mfrs. Assn.—Annual meeting, Sheraton-Brock Hotel, Niagara Falls, Ont., October 3-5.

International Assn. of Electrical Leagues — 27th annual conference, Sheraton-Chicago, Chicago, Ill., October 3-5.

National Electrical Contractors Assn. —Minneapolis Auditorium, Minneapolis, Minn., October 7-13.

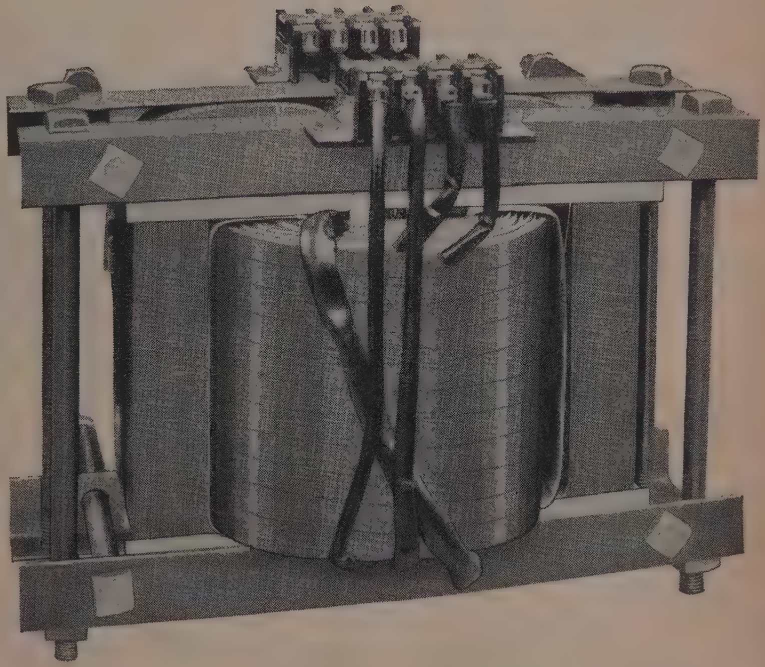
National Electronics Conference—McCormick Place, Chicago, Ill., October 8-10.

National Electrical Manufacturers Assn.—Annual meeting, Shoreham Hotel, Washington, D. C., week of November 12.

EASA DIRECTORS from opposite ends of the country met in St. Louis at a recent meeting of the association's board. At left, Earl S. Brooks, United Electric Motors, Seattle, Wash., with Edwin E. Kolhonen, Peabody Electric Motor Service, Peabody, Mass.

DONGAN
QUIET DRY TYPE
TRANSFORMERS

Dongan has specialized in the manufacture of dry type transformers for more than 50-years. This length of service to the electrical industry assures you of high quality, dependable transformers. Carefully built to your requirements, they will give long, quiet service.



DONGAN DRY-TYPE TRANSFORMERS are made in both class B 80° Cent. Rise and Class H 150° Cent. Rise. Single phase transformers, 25 V.A. to 100 KVA; three phase, 3 KVA to 300 KVA. Suitable for indoor or outdoor applications. Designed for wall or platform mounting. All have roomy wiring compartments.

Sizes 5 KVA and larger feature tap-changing and voltage-changing terminal board equipped with solderless connectors for speed hook-up. Built to meet or exceed NEMA specifications.

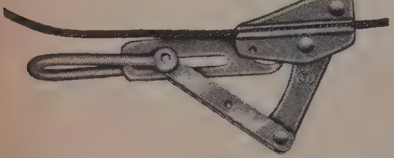
Dongan also makes transformers for-signaling-machine tools-control-buck and boost-high voltage secondary for oil and gas burners-neon signs.

DONGAN ELECTRIC MFG. COMPANY
2980 Franklin Street Detroit 7, Michigan
Telephone: LO 7-3974

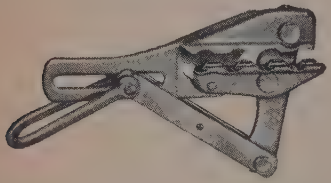
60 DIFFERENT KLEIN GRIPS MEET EVERY UTILITY NEED

If you want a strong, nonslipping grip for use on any type of conductor . . . if you need a pattern specially designed for hot line work . . . consult your Klein Catalog. Klein grips are designed for solid and stranded cable, for messenger guy strand and wire rope, and for weatherproof wire.

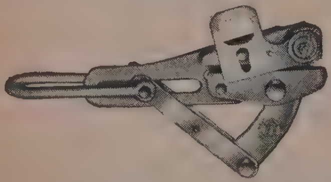
Write for the Klein Grip Selector to make sure you have the proper grip for every job.



1656-40B with bronze-lined jaws. Specially designed for bare A.C.S.R. aluminum and stranded copper cable.
Opening from .50 to .74 inch.



Machined jaws allow snaking insulated conductors, eliminating slippage and preventing conductor damage. Insulation does not have to be stripped from conductor.
1659-40—openings from .49 to .80 inch.



This hot line grip may be placed on wire with stick. Safety latch has three positions and closes automatically when stick is removed. Cannot fall off wire. Can be used for hot or dead work.
1628-5BH—openings from .198 to .522 inch.

FREE GRIP SELECTOR
To utility companies, the grip selector is available without charge. It shows the proper Klein grip for any type of wire and gives full information for servicing.

Foreign Distributor:
International Standard Electric
Corp., New York

Mathias KLEIN & Sons
Established 1857
Chicago Ill U S A
INCORPORATED
7200 McCORMICK ROAD, CHICAGO 45, ILL.

Among the Manufacturers

Headquarters Announcements

Multi-Amp Electronic Corp., Cranford, N. J., has announced the establishment of a Multi-Volt Div., to be managed by E. R. Redlhammer, executive vice president and T. M. Urban, chief engineer.

Dow Chemical Co., Midland, Mich., and **A. O. Smith Corp.**, Milwaukee, Wis., has announced the formation of **DowSmith Inc.**, to manufacture and market reinforced epoxy pipe and electrical equipment, with headquarters to be in Milwaukee. F. Shepard Cornell has been named president; Fran J. MacRae, vice president and general manager; Mark E. Kelly, Jr., manager of research and development.

Cutler-Hammer, Milwaukee, Wis., has acquired the assets of **Electric Distribution Products, Inc.**, Allentown, Pa., and the **Mullenbach division of Electric Machinery Mfg. Co.**, Los Angeles. Cutler-Hammer has organized a new corporation known as **Uni-Bus, Inc.** Elmer T. Carlson, formerly executive vice president of Electric Distribution Products, has been named president of the new corporation; R. A. Millermaster, vice president of engineering and development; E. B. Fitzgerald, administrative vice president of special assignments.

Wakefield Corp., Vermillion, Ohio, has announced the appointment of T. D. Wakefield, vice president of Electrical Products Group, to additional office of president and general manager of Wakefield Lighting Div.

General Electric Co., Cleveland, Ohio—Herman L. Weiss, vice president at Nela Park.

Westinghouse Electric Corp., Pittsburgh, Pa.—Tom Turner, special consultant on manufacturing; E. V. Huggins, executive vice president, associated activities; George L. Wilcox, vice president and deputy to executive vice president John K. Hodnette; Richard C. Niess, industrial sales manager, Air Conditioning Div., Staunton, Va.

Sylvania Electric Products Inc., New York, N. Y.—George C. Connor, general manager of new Home and Commercial Electronics Division.

Toledo Pipe Threading Machine Co., Toledo, Ohio, has acquired

CONNECT WITH
ETP
FOR ECONOMY

SOLID ONE-PIECE STEEL
•
U.L. APPROVED CONCRETE TIGHT COUPLINGS
•
CONNECTORS & OFFSETS ½" TO 2"
E.M.T. SET SCREW OR INDENTER TYPE

ELECTRICAL FITTINGS

Write Today For Samples & Brochure

ELECTRICAL TUBULAR PRODUCTS, INC.
74-15 GRAND AVENUE, MASPETH (NYC) N. Y.
DEfender 5-8000

Beaver Pipe Tools, Inc., Warren, Ohio. Russell Herig has been named sales manager of the division to be known as Toledo-Beaver Tools, Inc.

Ward Leonard Electric Co., Mt. Vernon, N. Y.—George M. Stapleton, president and general manager.

Tomic Sales & Engineering Co., Detroit, Mich.—Leslie E. Birger, general sales manager.

Graybar Electric Co., Inc., New York, N. Y.—John Reine, executive vice president.

Edwards Co., Inc., Norwalk, Conn.—Culver H. Griffin, market research manager.

Allen-Stevens Conduit Fittings Corp., Woodside, N. Y.—Ed Katz, sales manager.

A. O. Smith Corp., Milwaukee, Wis.—James F. Donnelly, Sr., executive director of marketing.

Steel City Electric Co., Pittsburgh, Pa.—William H. Satterfield, president.

Appleton Electric Co., Chicago, Ill.—James E. Gross, staff industrial engineer.

Federal Pacific Electric Co., Newark, N. J.—Bernard G. Tremblay, vice president.

Okonite Co., Passaic, N. J.—Elliot M. Nesvig, vice president of marketing.

Pittsburgh Reflector Co., Irwin, Pa.—Paul V. Hoppel, president.

Silvray Lighting, Inc., Bound Brook, N. J.—Howard A. Behren, advertising manager.

G&W Electric Specialty Co., Blue Island, Ill.—Roger Booty, manager, advertising and sales promotion; R. Zurowski, product manager for switchgear section; C. McGuire, product manager for cable-accessory section.

Columbia Metal Products Co., New York, N. Y.—W. L. Brown, vice president of sales.

Kaiser Aluminum & Chemical Sales, Inc., Oakland, Calif.—J. W. Loveland, national sales manager, Electrical Conductor Div., New York, N. Y.

Clayton Mark & Co., Evanston, Ill.—James B. Carse, vice president of marketing.

Continental Electric Equipment Co., Ludlow, Ky.—James K. Meader, general manager of field sales.

Volkswagen of America, Englewood Cliffs, N. J.—H. J. Ritscher, vice president.

Pendar, Inc., Van Nuys, Calif. —John C. Niver, manager of quality control.

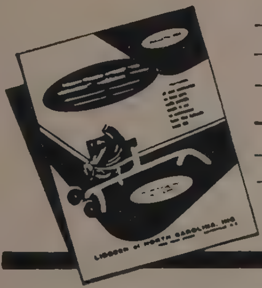
Corning Glass Works, Corning, N. Y.—William H. Hudson, man-

LIDSEEN
"Chicago" benders
are your
BEST BUY

Illustrated:
No. 5100 *for bending ½", ¾" and 1" rigid conduit*

It's designed by Electricians for Electricians!

Now! The Lidseen "Chicago" Bender meets the electrician's requirements more than ever. This improved "Chicago" bender incorporates all the additional features that electricians felt could make it the best on-the-job tool. It's lighter in weight, adjusts to any working height, wheels for easier portability and *all* models feature Lidseen's famous calibrated degree scale. **Lidseen "Chicago" Benders are at least twice as fast as hydraulic and work equally well on Aluminum or Steel Conduit.** Remember . . . before you buy just any bender, ask the electrician who is using a "Chicago" Bender; he will tell you it's the finest tool available and at a price that is eminently reasonable.



Bending Circles and Inside Radius

	No. 5100	No. 5300
½" Conduit or Pipe	2⁵⁄₁₆"	EMT 4"
¾" Conduit or Pipe	4⅛"	EMT 5"
1" Conduit or Pipe	5¼"	EMT 6"
	No. 5200	**No. 5400**
1¼" Conduit or Pipe	6⅞"	EMT 8"
1½" Conduit or Pipe	8¼"	EMT 10"

Write for NEW illustrated folder on How to Bend Conduit

LIDSEEN
OF NORTH CAROLINA, INC.
1050 FIRST STREET, HAYESVILLE
NORTH CAROLINA

Better than Ever ...and Any!

ARPS MODEL L-12

TRENCH DEVIL

- King Size capacities
- Digs to 5½' deep - 18" wide with no costly changeover
- Reversible conveyor - deposits dirt on either side of trench - no spill back.
- Absolutely straight - line trenches - no side thrust.
- Fingertip control - you see trenching progress at all times.
- Accurate depths via precision hydraulic control valve.
- Safety transport lever forward or reverse movement without gear shifting - no accidental "runaway".
- 46,000# tensile strength chain compared to 28,000# of competitive units.

Write for free brochure detailing the ARPS L-12 Trench Devil or Model M-A2 Trench Devil for smaller capacities

ARPS CORPORATION DEPT. CM

NEW HOLSTEIN, WISCONSIN

SINCE 1928

Trenchers • Half-Tracks • Dozers • Utility Blades

Circuit Breaker Test Unit

Standard ratings: 1, 2.5, 5, 7.5, 22.5 and 75 KVA

MULTI-AMP high-current, low voltage portable circuit breaker test units provide a safe, economical method for testing molded-case and low-voltage, single-pole or multi-pole power circuit breakers in the field, shop and laboratory. Multi-Amp engineers will gladly work with you in the design of special equipment for your specific needs. Bulletin SB-CB-1 on request.

MULTI-AMP® Electronic Corporation
61 Myrtle Street, Cranford, N. J. BRidge 6-8200

Portable, mobile, stationary and laboratory equipment to take the guesswork out of electrical protection and provide continuous power for continuous production.

ager of television product development, Electrical Products Div.

General Electric Co., Bridgeport, Conn.—Dr. Charles E. Reed, vice president, Chemical and Metallurgical Div.

General Electric Co., Waterford, N. Y.—Frank V. Summers, manager of finishing operations process engineering, Manufacturing Engineering Unit, Silicone Products Dept.

Regional Appointments

NEW ENGLAND

Edwin F. Guth Co.: P. L. Lepore, Arlington, Mass., sales representative for Maine, New Hampshire, Rhode Island, Vermont and parts of Massachusetts including Boston.

MIDDLE ATLANTIC

Day-Brite Lighting, Inc.: W. R. Becker, eastern regional manager, with headquarters in New York City.

G&W Electric Specialty Co.: C. V. Stevens, Inc., Buffalo, N. Y., sales representative in upper New York state region.

Sola Electrical Co.: William F. Cosgrove, district sales engineer for metropolitan New York area with headquarters in Little Ferry, N. J.

Continental Electric Equipment Co.: Adley Corp., Camden, N. J., sales representative in Philadelphia area.

Lake Shore Electric Corp.: Burnham Associates, Williamsville, N. Y., representative in western New York and Pennsylvania.

Allen-Stevens Conduit Fittings Corp.: L. Philip Ertel Co., Philadelphia, Pa., representative for southeastern Pennsylvania, southern New Jersey and Delaware.

Allis-Chalmers Mfg. Co.: Walter M. Johnson, manager of Syracuse district, Industries Group.

SOUTH ATLANTIC

H. K. Porter Co., Inc.: Howard D. Tindall, works manager of new Lynchburg, Va., works; Delta-Star Electric Div.

EAST CENTRAL

Dayco Corp.: Robert F. Schreiber, midwestern regional manager, Industrial Sales Dept., Rubber Products Div., with headquarters in Chicago.

Owatonna Tool Co.: M. Donald Garrison, district manager for Detroit, Michigan and northern Ohio territory.

Wesix Electric Heater Co.:

Cable-Hight Co., Cleveland, representative in northern Ohio.

Continental Electric Equipment Co.: Campbell/Smith Sales Agency, Memphis and Nashville, Tenn., sales representative for Tennessee.

Mathias Klein & Sons: Joseph H. Binder, district manager of Chicago area.

Allis-Chalmers Mfg. Co.: D. C. Emery, manager, utility sales, Cleveland district; Norman L. Danforth, manager of Cincinnati district; W. F. Bueche, manager of Detroit district; Earl R. Narum, manager of Toledo district; Industries Group.

Champion Lamp Works: Tom W. Bullock, Louisville, Ky., manufacturer's representative; John F. Harkey, Indianapolis, Ind., manufacturer's representative.

WEST CENTRAL

Champion Lamp Works: Jim Tuite, Dallas, representative for Texas and Oklahoma.

C & D Batteries, Div. of Electric Autolite Co.: Brice Machinery and Controls Co., Houston, Texas, representative in Houston.

Bogen-Presto Div., Siegler Corp.: Pat Aylward & Co., Minneapolis, factory sales representative in Minnesota, North Dakota, South Dakota and western Wisconsin.

Hykon Mfg. Co.: Delta Materials, Inc., New Orleans, representative in Louisiana-Mississippi area.

WEST

Sierra Electric Corp.: Larry Keeshen, district sales manager for southern California and Nevada.

Brand-Rex Div., American Enka Corp.: Malcolm C. Jefferies, sales engineer in northern California and Nevada, with headquarters in Sunnyvale, Calif.

Allis-Chalmers Mfg. Co.: G. K. Lewis, manager, San Francisco district; W. C. Henderson, manager, Portland district; Industries Group.

Panellit, Div. of ISI, Inc.: T. A. Dobbie, Jr., western regional sales manager, for all states west of the Rocky Mountains, with headquarters in Los Angeles.

Bogen-Presto Div., Siegler Corp.: Heaton-Marco Associates, San Francisco, factory sales representative in northern California and northern Nevada.

Champion Lamp Works: Dale Brown, Salt Lake City, representative for Utah, Idaho, and Montana.

this
UNIPAK®
can
SLASH
YOUR
ELECTRIC
BILL

It's no secret. It's one of Sprague Electric's power factor correction capacitors — proved in engineering principle . . . made by the world's largest capacitor manufacturer . . . listed by Underwriters' Laboratories . . . used by leading manufacturers the world over. Here's why—

Motors and similar equipment in your plant use both kilowatts (working current) and kilovars (magnetizing current). The kilowatts you buy from your electric company. The kilovars you can best supply yourself with Sprague power factor correction capacitors. And the more you supply, the greater your useful power, the less the load on present wiring, the lower your electric bill.

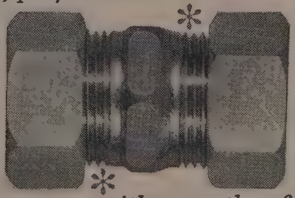
You can get a free estimate of potential savings in your plant, or literature giving more details by writing Sprague Electric Co., 333 Marshall Street, North Adams, Massachusetts.

In Canada, write John R. Tilton Ltd., 51 McCormack St., Toronto 9, Ont.

SPRAGUE®
world's largest capacitor manufacturer

COMPARE*

Blackhawk's full, perfect threads



with any other fittings on the market

See for yourself that Blackhawk EMT fittings have full, true, perfect threads for ease and speed of installation. Bodies of heavy steel or malleable iron — cadmium and zinc finished to eliminate corrosion on the unit itself. Blackhawk's new EMT fittings are rain tight. Quality controlled at every phase of the manufacturing. Available in complete range of sizes.

Find out why these small, easy to use fittings are best for any electrical job, large or small.

SEND THIS COUPON TODAY

COMPARE BLACKHAWK'S FULL PERFECT THREADS
SEND FOR YOUR FREE SAMPLE
Blackhawk Industries, Box 708, Dubuque, Iowa ECM-22
Please send my free sample of Blackhawk fittings.
Name
Address
City State
Blackhawk Industries, Dubuque, Iowa
Where the new ideas come from

Latrobe PRODUCTS
★ FLOOR BOXES ★ WIRING SPECIALTIES ★

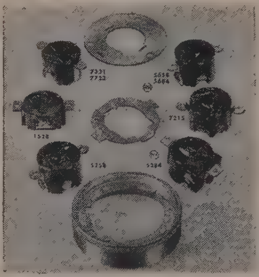
FULLMAN
Add Receptacle Yourself
SERIES

190
ADJUSTABLE
STEEL BOX

Steel Box with a 3¼" diameter brass cover plate There are two ½" and two ¾" KO's in sides and two ¾" and three ½" KO's in bottom. Comes in two standard heights—3⅛" and 2⅝" minimum. Designed for power or telephone service.

122
CAST IRON
BOX

Adjustable Floor Box with cast iron box body. Contains all the same advantages, receptacles adaptability, etc., as found in Fullman's No. 190 series steel-bodied floor boxes. Brass or Aluminum Top Assemblies to go with nozzles at no extra cost.



Adjusting ring for our #122and #190 series is so designed that "KEY" (shown in center of photo) drops easily into special slots. You select the receptacle required and simply "LAY-IN"; then "LAY-ON" receptacle ring. This has been added at no extra cost.

FULLMAN'S NEW MODERN
#307 SERIES

This new compact, modern, attractive, streamlined Receptacle or Telephone Nozzle comes in brass (lacquered) or anodized aluminum. They are made single or double (back to back) and include 1" nipple.
Height 2⅜"—Width 2⅜"—Length 3½". One inch shorter in length than standard under floor duct nozzles.

Visit our Booth #408
Nat'l. Elec. Industries Show

Sold Only Thru Wholesalers

Fullman
MANUFACTURING COMPANY
1209-1215 JEFFERSON ST.
LATROBE, PENNSYLVANIA

PRIMARY DISTRIBUTION POWERS A COLLEGE

[FROM PAGE 81]

an experiment they may be placed on top of the platform within easy reach of students.

Machine Shop

Besides receiving regular classroom instruction, students in mechanical technology attend various laboratory and shop sessions. In the machine shop they operate various metal-working machines.

A 225-amp, 600-volt, 4-wire busway, 100 ft long, extends over the length of the 4000-sq-ft shop. Fused switches, plugged into this horizontally mounted busway, supply circuits that are run in conduit to each machine.

To provide extra safety for the student machine operators, four emergency stop buttons are located in strategic areas. If an emergency arises, pressing any one of the four buttons will de-energize the busway, immediately stopping all machines.

Series Street Lighting

A 2400-volt series lighting system illuminates entrance roads, parking areas and sidewalks. From the primary switchgear, one No. 2, 5-kv cable and one No. 4 TW neutral carry 2400 volts through a remote-controlled 2500-volt oil switch to the constant-current transformer. Oil-cooled, this 20-kw current regulator provides a constant current of 6.6 amps on the lighting circuit.

From the regulator, two No. 6 rubber-insulated, neoprene-jacketed, direct-burial, single-conductor cables extend underground to each lamp post. Within the base of each aluminum standard, the underground cables terminate in a pothead, from which a duplex No. 10, rubber-insulated 5-kv cable, continues up the standard to the luminaire. Mounted on 25-ft-high single- or double-arm standards, incandescent lamps, equipped with tear-drop diffusers, illuminate roadways and parking areas. On 10-ft high standards, post-top units with opal globes light pathways. All luminaires are rated 6.6 amps, 4000 lumens.

SEND FOR THIS
MANUAL on INSULATION TESTING

of Cables, Wiring, Motors, Transformers, Capacitors, Appliances

For better maintenance and production testing . . request Manual D-62.

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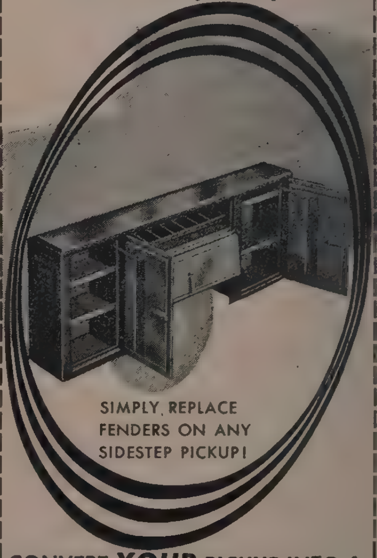

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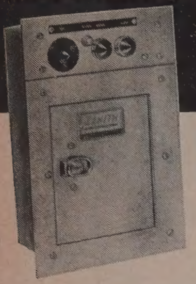

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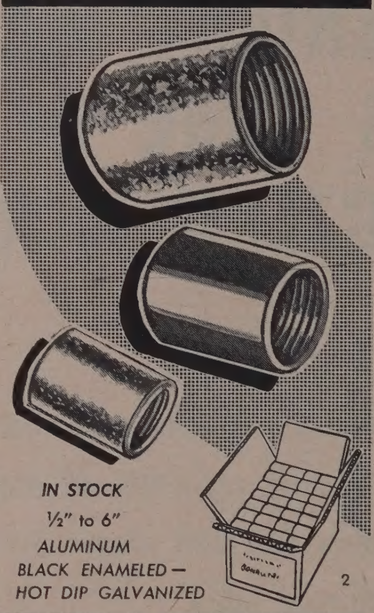

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PRIMARY DISTRIBUTION POWERS A COLLEGE

[FROM PAGE 184]

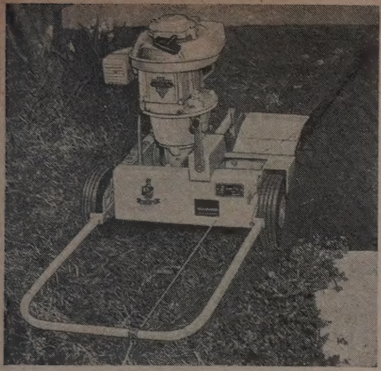
Utilizing about 50 different types of fixtures, both fluorescent and incandescent lighting provide illumination throughout the college. Entrance fixtures and cafeteria lighting are particularly interesting.

Located in the Student Union building, the cafeteria-lounge lighting typifies the modern decor of the school. Here, mounted *above* a special ceiling, 162 floodlamps, rated at 150 watts each, provide illumination for the 7500-sq-ft area. Besides adding to the beauty of the cafeteria, the ceiling, consisting of hundreds of small concave disks, serves as a light diffuser. These disks are connected together to form a large net-like blanket. Draped along the length of the room, the assembly is hung from the walls and overhead steel. The above-ceiling floodlamps, evenly spaced about 1 ft over the netting, allow plenty of light to filter down through the spaces between disks. This arrangement provides a brilliantly lighted cafeteria with light sources almost invisible.

In the lounge area, nine 100-watt incandescent lamps supplement the lighting. These lamps, equipped with modern saucer-like fixtures, hang below the ceiling on ¼ in. rods. Mounted 7½ ft above the floor, they were intended primarily for their architectural effect.

"Hanging garden" lighting units illuminate the exterior entrances to each building. Saucer-like in appearance, these custom-made fixtures are 10 ft in diameter and are constructed primarily of ¼-in. plate steel. Two 150-watt floodlamps are the light sources. Both floodlamps are mounted in the center of the fixture in a duplex lampholder; one directs light upward; the other directs light downward. In warm weather, ivy or other green plants will hang from the perimeter of the planter-fixture adding to modern beauty of the college.

Architects were Edward D. Stone, New York City, and Bice & Bard, Utica, N. Y. Jaros, Baum and Bolles of New York City were the consulting engineers. Electrical work was done by Rao Electric Equipment Co., New York City.



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ARKLA Gas Company of Wichita, Kansas, found that six Davis Pups paid for themselves in two months installing gas lights, and subsequently purchased 20 more.

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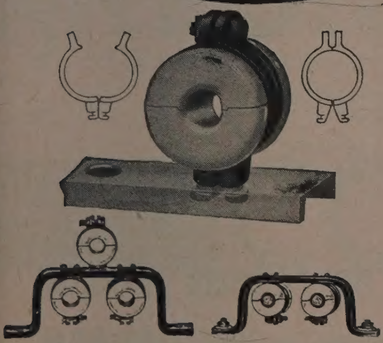

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WIRING A SHOPPING CENTER

[FROM PAGE 94]

turer. Interior sign units are approximately 159-ft long and require eight separate electrical circuits.

The outdoor parking area is also well lighted with 1500-ma, 8-ft fluorescent lamps—four lamps in each pole-mounted luminaire. These luminaires are end mounted in wing fashion with two per pole. A 480/-277-volt system was used for the parking lights. Even with the long runs of approximately 700 ft, the voltage drop at the fixtures meets the 1% requirements. The circuit runs within the store for lighting and power sometimes exceeded 300 ft in length, and again the voltage drops in these runs were just below the 1% figure for the lighting circuits and less than 3% for the power runs.

Careful attention to voltage drop during circuit design is the only sure way to guarantee maximum performance from the equipment and to keep maintenance due to overloading and overheating to a minimum. It also assures the owners of the best lighting levels through the entire store and parking areas. The accomplishment of low voltage drops in circuits was made both by up-sizing wire sizes and limiting current loads. And, it should be noted, provision of low voltage drops assures minimum expenditure of useless energy loss in wires.

TOOL MAINTENANCE man John Beiler checks operation of mobile welding unit used on vast LA airport expansion job by Fischbach and Moore. Electrical work in 24 major structures scattered over a 265-acre site approximated $5-million and covered a 2-year construction period.

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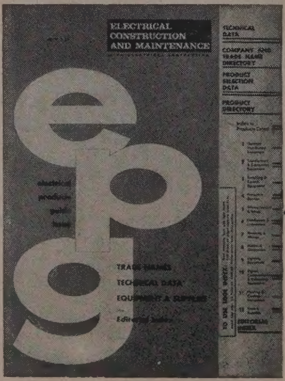
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